SERIAL 05165 RFP GEODATABASE DESIGN – FLOOD CONTROL

DATE OF LAST REVISION: March 23, 2006 CONTRACT END DATE: March 31, 2007

CONTRACT PERIOD THROUGH MARCH 31, 2007

TO: All Departments

FROM: Department of Materials Management

SUBJECT: Contract for **GEODATABASE DESIGN – FLOOD CONTROL**

Attached to this letter is published an effective purchasing contract for products and/or services to be supplied to Maricopa County activities as awarded by Maricopa County on **March 23, 2006 (Eff. 04/01/06).**

All purchases of products and/or services listed on the attached pages of this letter are to be obtained from the vendor holding the contract. Individuals are responsible to the vendor for purchases made outside of contracts. The contract period is indicated above.

_____

Wes Baysinger, Director
Materials Management

LC/mm
Attach

Copy to: Clerk of the Board
Marta Dent, Flood Control
Mirheta Muslic, Materials Management

CONTRACT PURSUANT TO RFP

SERIAL 05165-RFP

This Contract is entered into this 1st day of APRIL, 2006 by and between Maricopa County ("County"), a political subdivision of the State of Arizona, and DEWBERRY & DAVIS, LLC, an Virgina corporation ("Contractor") for the purchase of GEODATABASE CONSULTING AND DESIGN services.

1.0 TERM

1.1 This Contract is for a term of One (1) year, beginning on the 1st day of APRIL, 2006 and ending the 31st day of MARCH, 2007.

1.2 The County may, at its option and with the agreement of the Contractor, extend the period of this Contract for additional terms up to a maximum of One (1) year. The County shall notify the Contractor in writing of its intent to extend the Contract period at least thirty (30) calendar days prior to the expiration of the original contract period, or any additional term thereafter.

2.0 PAYMENT

2.1 As consideration for performance of the duties described herein, County shall pay Contractor the sum(s) stated in Exhibit "A."

2.2 Payment shall be made upon the County's receipt of a properly completed invoice. Invoices shall contain the following information: Contract number, purchase order number, description services, unit prices, extended totals and any applicable sales/use tax.

3.0 DUTIES

3.1 The Contractor shall perform all duties stated in Exhibit "B."

3.2 The Contractor shall perform services at the location(s) and time(s) stated in Exhibit "B," or as otherwise directed in writing.

3.3 During the Contract term, County shall provide Contractor's personnel with adequate workspace for consultants and such other related facilities as may be required by Contractor to carry out its contractual obligations.

4.0 TERMS & CONDITIONS

4.1 INDEMNIFICATION:

Contractor agrees to indemnify and hold harmless the County, its agents, representatives, officers, directors, officials, and employees from and against all claims, damages, losses, and expenses, including but not limited to reasonable attorney fees and costs, to the extent arising from Contractor's negligent acts or omissions in the performance of services under this Contract, or arising from Contractor's intentional misconduct.

The amount and type of insurance coverage requirements set forth herein will in no way be construed as limiting the scope of the indemnity in this paragraph.

The scope of this indemnification does not extend to the sole negligence of County.

4.2 INSURANCE REQUIREMENTS:

Contractor, at Contactor's own expense, shall purchase and maintain the herein stipulated minimum insurance from a company or companies duly licensed by the State of Arizona and possessing a current A.M. Best, Inc. rating of B++6. In lieu of State of Arizona licensing, the stipulated insurance may be purchased from a company or companies, which are authorized to do business in the State of Arizona, provided that said insurance companies meet the approval of County. The form of any insurance policies and forms must be acceptable to County.

All insurance required herein shall be maintained in full force and effect until all work or service required to be performed under the terms of the Contract is satisfactorily completed and formally accepted. Failure to do so may, at the sole discretion of County, constitute a material breach of this Contract.

Contractor's insurance shall be primary insurance as respects County, and any insurance or self-insurance maintained by County shall not contribute to it.

Any failure to comply with the claim reporting provisions of the insurance policies or any breach of an insurance policy warranty shall not affect the County's right to coverage afforded under the insurance policies.

The insurance policies may provide coverage that contains deductibles or self-insured retentions. Such deductible and/or self-insured retentions shall not be applicable with respect to the coverage provided to County under such policies. Contactor shall be solely responsible for the deductible and/or self-insured retention and County, at its option, may require Contractor to secure payment of such deductibles or self-insured retentions by a surety bond or an irrevocable and unconditional letter of credit.

County reserves the right to request and to receive, within 10 working days, certified copies of any or all of the herein required insurance policies and/or endorsements. County shall not be obligated, however, to review such policies and/or endorsements or to advise Contractor of any deficiencies in such policies and endorsements, and such receipt shall not relieve Contractor from, or be deemed a waiver of County's right to insist on strict fulfillment of Contractor's obligations under this Contract.

The insurance policies required by this Contract, except Workers' Compensation, and Errors and Omissions, shall name County, its agents, representatives, officers, directors, officials and employees as Additional Insureds.

The policies required hereunder, except Workers' Compensation, and Errors and Omissions, shall contain a waiver of transfer of rights of recovery (subrogation) against County, its agents, representatives, officers, directors, officials and employees for any claims arising out of Contractor's work or service.

Contractor is required to procure and maintain the following coverages indicated by a checkmark:

4.2.1 Commercial General Liability.

Commercial General Liability insurance and, if necessary, Commercial Umbrella insurance with a limit of not less than $1,000,000 for each occurrence, $2,000,000 Products/Completed Operations Aggregate, and $2,000,000 General Aggregate Limit. The policy shall include coverage for bodily injury, broad form property damage, personal injury, products and completed operations and blanket contractual coverage, and shall not contain any provision which would serve to limit third party action over claims. There shall be no endorsement or modification of the CGL limiting the scope of coverage for liability arising from explosion, collapse, or underground property damage.

4.2.2 Automobile Liability.

Commercial/Business Automobile Liability insurance and, if necessary, Commercial Umbrella insurance with a combined single limit for bodily injury and property damage of not less than $1,000,000 each occurrence with respect to any of the Contractor's owned, hired, and non-owned vehicles assigned to or used in performance of the Contractor's work or services under this Contract.

4.2.3 Workers' Compensation.

Workers' Compensation insurance to cover obligations imposed by federal and state statutes having jurisdiction of Contractor's employees engaged in the performance of the work or services under this Contract; and Employer's Liability insurance of not less than $100,000 for each accident, $100,000 disease for each employee, and $500,000 disease policy limit.

Contractor waives all rights against County and its agents, officers, directors and employees for recovery of damages to the extent these damages are covered by the Workers' Compensation and Employer's Liability or commercial umbrella liability insurance obtained by Contractor pursuant to this Contract.

4.2.4 Errors and Omissions Insurance.

Errors and Omissions insurance and, if necessary, Commercial Umbrella insurance, which will insure and provide coverage for errors or omissions of the Contractor, with limits of no less than $1,000,000 for each claim.

4.2.5 Certificates of Insurance.

4.2.5.1 Prior to commencing work or services under this Contract, Contractor shall have insurance in effect as required by the Contract in the form provided by the County, issued by Contractor's insurer(s), as evidence that policies providing the required coverage, conditions and limits required by this Contract are in full force and effect. Such certificates shall be made available to the County upon 48 hours notice. **BY SIGNING THE AGREEMENT PAGE THE CONTRACTOR AGREES TO THIS REQUIREMENT AND UNDERSTANDS THAT FAILURE TO MEET THIS REQUIREMENT WILL RESULT IN CANCELLATION OF THIS CONTRACT.**

In the event any insurance policy (ies) required by this Contract is (are) written on a "claims made" basis, coverage shall extend for two (2) years past completion and acceptance of Contractor's work or services and as evidenced by annual Certificates of Insurance.

If a policy does expire during the life of the Contract, a renewal certificate must be sent to County fifteen (15) days prior to the expiration date.

4.2.5.2 Cancellation and Expiration Notice.

Insurance required herein shall not be permitted to expire, be canceled, or materially changed without thirty (30) days prior written notice to the County.

4.5 NOTICES:

All notices given pursuant to the terms of this Contract shall be addressed to:

For County:

Maricopa County
Department of Materials Management
Attn: Director of Purchasing
320 West Lincoln Street
Phoenix, Arizona

For Contractor:

Dewberry & Davis, LLC
8401 Arlington Blvd.
Fairfax, Virginia 22031-4666
Attn: Mike Beardslee
703-849-0695
703-849-0718 Fax

4.6 REQUIREMENTS CONTRACT:

4.6.1 Contractor signifies its understanding and agreement by signing this document that this Contract is a requirements contract. This Contract does not guarantee any purchases will be made (minimum or maximum). Orders will only be placed when County identifies a need and issues a purchase order or a written notice to proceed.

4.6.2 County reserves the right to cancel purchase orders or notice to proceed within a reasonable period of time after issuance. Should a purchase order or notice to proceed be canceled, the County agrees to reimburse the Contractor for actual and documented costs incurred by the Contractor. The County will not reimburse the Contractor for any avoidable costs incurred after receipt of cancellation, or for lost profits, or shipment of product or performance of services prior to issuance of a purchase order or notice to proceed.

4.7 PRICE ADJUSTMENTS:

Any requests for reasonable price adjustments must be submitted sixty (60) days prior to the Contract expiration date. Requests for adjustment in cost of labor and/or materials must be supported by appropriate documentation. If County agrees to the adjusted price terms, County shall issue written approval of the change. The reasonableness of the request will be determined by comparing the request with the (Consumer Price Index) or by performing a market survey.

4.8 TERMINATION FOR CONVENIENCE:

The County reserves the right to terminate the Contract, in whole or in part at any time, when in the best interests of the County without penalty or recourse. Upon receipt of the written notice, the Contractor shall immediately stop all work, as directed in the notice, notify all subcontractors of the effective date of the termination and minimize all further costs to the County. In the event of termination under this paragraph, all documents, data and reports prepared by the Contractor under the Contract shall become the property of and be delivered to the County upon demand. The Contractor shall be entitled to receive just and equitable compensation for work in progress, work completed and materials accepted before the effective date of the termination.

4.9 TERMINATION FOR DEFAULT:

4.9.1 In addition to the rights reserved in the Contract, the County may terminate the Contract in whole or in part due to the failure of the Contractor to comply with any term or

condition of the Contract, to acquire and maintain all required insurance policies, bonds, licenses and permits, or to make satisfactory progress in performing the Contract. The Procurement Officer shall provide written notice of the termination and the reasons for it to the Contractor.

4.9.2 Upon termination under this paragraph, all goods, materials, documents, data and reports prepared by the Contractor under the Contract shall become the property of and be delivered to the County on demand.

4.9.3 The County may, upon termination of this Contract, procure, on terms and in the manner that it deems appropriate, materials or services to replace those under this Contract. The Contractor shall be liable to the County for any excess costs incurred by the County in procuring materials or services in substitution for those due from the Contractor.

4.9.4 The Contractor shall continue to perform, in accordance with the requirements of the Contract, up to the date of termination, as directed in the termination notice.

4.10 STATUTORY RIGHT OF CANCELLATION FOR CONFLICT OF INTEREST:

Notice is given that pursuant to A.R.S. §38-511 the County may cancel this Contract without penalty or further obligation within three years after execution of the contract, if any person significantly involved in initiating, negotiating, securing, drafting or creating the contract on behalf of the County is at any time while the Contract or any extension of the Contract is in effect, an employee or agent of any other party to the Contract in any capacity or consultant to any other party of the Contract with respect to the subject matter of the Contract. Additionally, pursuant to A.R.S §38-511 the County may recoup any fee or commission paid or due to any person significantly involved in initiating, negotiating, securing, drafting or creating the contract on behalf of the County from any other party to the contract arising as the result of the Contract.

4.11 OFFSET FOR DAMAGES;

In addition to all other remedies at law or equity, the County may offset from any money due to the Contractor any amounts Contractor owes to the County for damages resulting from breach or deficiencies in performance under this contract.

4.12 ADDITIONS/DELETIONS OF SERVICE:

The County reserves the right to add and/or delete products and/or services provided under this Contract. If a requirement is deleted, payment to the Contractor will be reduced proportionately to the amount of service reduced in accordance with the proposal price. If additional services and/or products are required from this Contract, prices for such additions will be negotiated between the Contractor and the County.

4.13 SUBCONTRACTING:

The Contractor may not assign this Contract or subcontract to another party for performance of the terms and conditions hereof without the written consent of the County, which shall not be unreasonably withheld. All correspondence authorizing subcontracting must reference the Proposal Serial Number and identify the job project.

4.14 AMENDMENTS:

All amendments to this Contract must be in writing and signed by both parties.

4.15 RETENTION OF RECORDS:

The Contractor agrees to retain all financial books, records, and other documents relevant to this Contract for five (5) years after final payment or until after the resolution of any audit questions which could be more than five (5) years, whichever is longer. The County, Federal or State

auditors and any other persons duly authorized by the Department shall have full access to, and the right to examine, copy and make use of, any and all said materials.

If the Contractor's books, records and other documents relevant to this Contract are not sufficient to support and document that requested services were provided, the Contractor shall reimburse Maricopa County for the services not so adequately supported and documented.

4.16 AUDIT DISALLOWANCES:

If at any time, County determines that a cost for which payment has been made is a disallowed cost, such as overpayment, County shall notify the Contractor in writing of the disallowance. County shall also state the means of correction, which may be but shall not be limited to adjustment of any future claim submitted by the Contractor by the amount of the disallowance, or to require repayment of the disallowed amount by the Contractor.

4.17 ALTERNATIVE DISPUTE RESOLUTION:

4.17.1 After the exhaustion of the administrative remedies provided in the Maricopa County Procurement Code, any contract dispute in this matter is subject to compulsory arbitration. Provided the parties participate in the arbitration in good faith, such arbitration is not binding and the parties are entitled to pursue the matter in state or federal court sitting in Maricopa County for a de novo determination on the law and facts. If the parties cannot agree on an arbitrator, each party will designate an arbitrator and those two arbitrators will agree on a third arbitrator. The three arbitrators will then serve as a panel to consider the arbitration. The parties will be equally responsible for the compensation for the arbitrator(s). The hearing, evidence, and procedure will be in accordance with Rule 74 of the Arizona Rules of Civil Procedure. Within ten (10) days of the completion of the hearing the arbitrator(s) shall:

4.17.1.1 Render a decision;

4.17.1.2 Notify the parties that the exhibits are available for retrieval; and

4.17.1.3 Notify the parties of the decision in writing (a letter to the parties or their counsel shall suffice).

4.17.2 Within ten (10) days of the notice of decision, either party may submit to the arbitrator(s) a proposed form of award or other final disposition, including any form of award for attorneys' fees and costs. Within five (5) days of receipt of the foregoing, the opposing party may file objections. Within ten (10) days of receipt of any objections, the arbitrator(s) shall pass upon the objections and prepare a signed award or other final disposition and mail copies to all parties or their counsel.

4.17.3 Any party which has appeared and participated in good faith in the arbitration proceedings may appeal from the award or other final disposition by filing an action in the state or federal court sitting in Maricopa County within twenty (20) days after date of the award or other final disposition. Unless such action is dismissed for failure to prosecute, such action will make the award or other final disposition of the arbitrator(s) a nullity.

4.18 SEVERABILITY:

The invalidity, in whole or in part, of any provision of this Contract shall not void or affect the validity of any other provision of this Contract.

4.19 RIGHTS IN DATA:

The County shall own have the use of all data and reports resulting from this Contract without additional cost or other restriction except as provided by law. Each party shall supply to the other

party, upon request, any available information that is relevant to this Contract and to the performance hereunder.

4.20 INTEGRATION:

This Contract represents the entire and integrated agreement between the parties and supersedes all prior negotiations, proposals, communications, understandings, representations, or agreements, whether oral or written, express or implied.

4.21 GOVERNING LAW:

This Contract shall be governed by the laws of the state of Arizona. Venue for any actions or lawsuits involving this Contract will be in Maricopa County Superior Court or in the United States District Court for the District of Arizona, sitting in Phoenix, Arizona

IN WITNESS WHEREOF, this Contract is executed on the date set forth above.

CONTRACTOR

_____
AUTHORIZED SIGNATURE

_____
PRINTED NAME AND TITLE

_____
ADDRESS

_____
DATE

MARICOPA COUNTY

BY: _____ _____
DIRECTOR, MATERIALS MANAGEMENT DATE

BY: _____ _____
CHAIRMAN, BOARD OF SUPERVISORS DATE

ATTESTED:

_____ _____
CLERK OF THE BOARD DATE

APPROVED AS TO FORM:

_____ _____
DEPUTY MARICOPA COUNTY ATTORNEY DATE

EXHIBIT A
PRICING

SERIAL 05165-RFP
PRICING SHEET: S073710B0700175/NIGP 92018

BIDDER NAME:	Dewberry & Davis LLC
VENDOR #:	W000003603
BIDDER ADDRESS:	8401 Arlington Blvd., Fairfax, Virginia 22031
P.O. ADDRESS:	Same as Bidder Address
BIDDER PHONE #:	703.849.0695
BIDDER FAX #:	703.849.0182
COMPANY WEB SITE:	http://www.dewberry.com
COMPANY CONTACT (REP):	Mike Beardslee
E-MAIL ADDRESS (REP):	mbeardslee@dewberry.com

WILLING TO ACCEPT FUTURE SOLICITATIONS VIA EMAIL: ___X__ YES _____ NO

ACCEPT PROCUREMENT CARD: ___X__ YES _____ NO

REBATE (CASH OR CREDIT) FOR UTILIZING PROCUREMENT CARD: ___ YES ___X__ NO ___ %
REBATE (Payment shall be made within 48 hrs utilizing the Purchasing Card)

INTERNET ORDERING CAPABILITY: _____ YES ___X__ NO _____ % DISCOUNT

OTHER GOV'T. AGENCIES MAY USE THIS CONTRACT: ___X__YES _____ NO

PAYMENT TERMS: NET 30 __X_

INDICATE PERCENTAGE OF M/WBE PARTICIPATION IF ANY HERE:____0_____%

1.0 PRICING:

1.1 GEODATABASE

		TOTAL COST	TOTAL HOURS
1.1.1	Information Needs Assessment (Per 2.3.1)	$156,895.83	1,198.00

1.2 DESIGNMODULE PRICING – DELIVERABLES
OPTIONAL* - MODULE PRICING - DELIVERABLES

The following Deliverables will be contracted at the discretion of Maricopa County Flood Control District
Based on requirements and available funding.
Separate Purchase Orders will be issued for each Deliverable

		TOTAL COST	TOTAL HOURS
1.2.2	Geodatabase Design (Per 2.3.2)	$186,518.72	1,549.00
1.2.3	Prototype Development (Per 2.3.3)	$112,222.94	1,057.00
1.2.4	Geodatabase Migration (Per 2.3.4)	$127,704.79	1,204.00
1.2.5	Operational Documentation & Training (Per 2.3.5)	$61,442.61	480.00
1.2.6	Application Planning (Per 2.3.6)	$12,118.80	102.00

		TOTAL COST	TOTAL HOURS
	GEODATABASE DESIGN TOTAL PROJECT COST Per Section 2.0 Scope of Work	$656,903.69	5,590.00

1.3 PRICING	**HOURLY COST**	
1.3.1	Principal	$186.56/Hour
1.3.2	Project Manager	$126.64/Hour
1.3.3	Deputy Project Manager	$113.95/Hour
1.3.4	Technical Advisor	$125.54/Hour
1.3.5	Sr GIS Specialist	$129.03/Hour
1.3.6	Senior Programmer	$131.87/Hour
1.3.7	Programmer	$85.49/Hour
1.3.8	Database Analyst	$75.68/Hour
1.3.9	Sr GIS Analyst	$80.45/Hour
1.3.10	GIS Analyst	$51.80/Hour

Hourly Rates may be utilized for requirements outside the scope of the Contract

EXHIBIT B
SCOPE OF WORK

1.0 INTENT:

To provide the Flood Control District of Maricopa County (the District) professional services related to the design of an enterprise geodatabase to be deployed in a relational database management system (RDBMS) consisting of Microsoft SQL Server 2000 and ESRI's ArcSDE 9. For the purposes of this document, the term Enterprise shall refer to the Flood Control District and/or the Public Works Agency of Maricopa County.

Content for the geodatabase will be extracted from the District's Hydrologic Information System (HIS) and recast to fit the new data model. Migration to a geodatabase will ensure that the District's existing spatial datasets remain compatible with emergent developments in geo-technology; thus protecting a substantial public investment.

This acquisition is intended to support the four Strategic Programs of the District:

I. Flood Hazard Education: The District raises public awareness by providing flood hazard education and information. The geodatabase will be a premier repository for the distribution of spatial, flood hazard data to the public through web-based applications.

II. Identification of Flood Hazards: The District contributes to regional planning and development activities through the identification of flood hazards. The mapping and visualization that can be performed against a geodatabase will extend the analysis of modeling output from various engineering software used to identify flood hazards.

III. Flood Hazard Regulation: The District implements flood hazard regulations to maintain a safe balance between the exercise of property rights and encroachment within floodplains. The geodatabase will enable near- and long-term environmental monitoring of activities affecting flood hazard zones.

Flood Hazard Remediation: The District protects the public through a structural approach to flood hazard remediation. The mapping, storage, and monitoring capabilities of the geodatabase will supplement the management of flood control structures (particularly those designated as "key assets" by the Department of Homeland Security).

2.0 SCOPE OF WORK:

The primary goal of this acquisition is the implementation of a comprehensive, enterprise geodatabase capable of supporting the District's broad range of scientific, technical, regulatory, and maintenance activities. The Scope of Work for achieving these goals and providing the mandated deliverables are outlined below.

2.1 INFORMATION NEEDS ASSESSMENT (INA):

Conduct an Information Needs Assessment (INA) by reviewing spatial *and* non- spatial data repositories, processes and requirements at the District in preparation of a preliminary SDE geodatabase schema design and prepare a preliminary migration plan.

Dewberry believes that a modest expansion in the scope and structure of this needs assessment to include an analysis of key business processes, application requirements (both existing and anticipated), and an evaluation of industry standard models and specifications, will better serve FCDMC by more closely aligning the resulting data model with business requirements. We will also perform a preliminary analysis of training requirements during this phase. An outline of the analyses covered by our proposed approach is therefore as follows:

- *Business Process Analysis*
  - *Meet with key District members to evaluate and document key business processes (as related to the current and anticipated use of geographic information);*
  - *Concurrently, interview District staff to uncover additional unmet needs (existing and anticipated); and*
  - *Document business processes and needs.*

- *Data Analysis (existing data holdings)*
  - *Inventory and evaluation of existing H.I.S.;*
  - *Inventory and evaluate other non-spatial data for inclusion in the new geodatabase;*
  - *Inventory spatial data from outside agencies; recommend measures for integration;*
  - *Analyze Maricopa County street centerline data; recommend measures for integration; and*
  - *Evaluate security requirements for all data; recommend measures for protection of spatial data for sensitive infrastructure.*

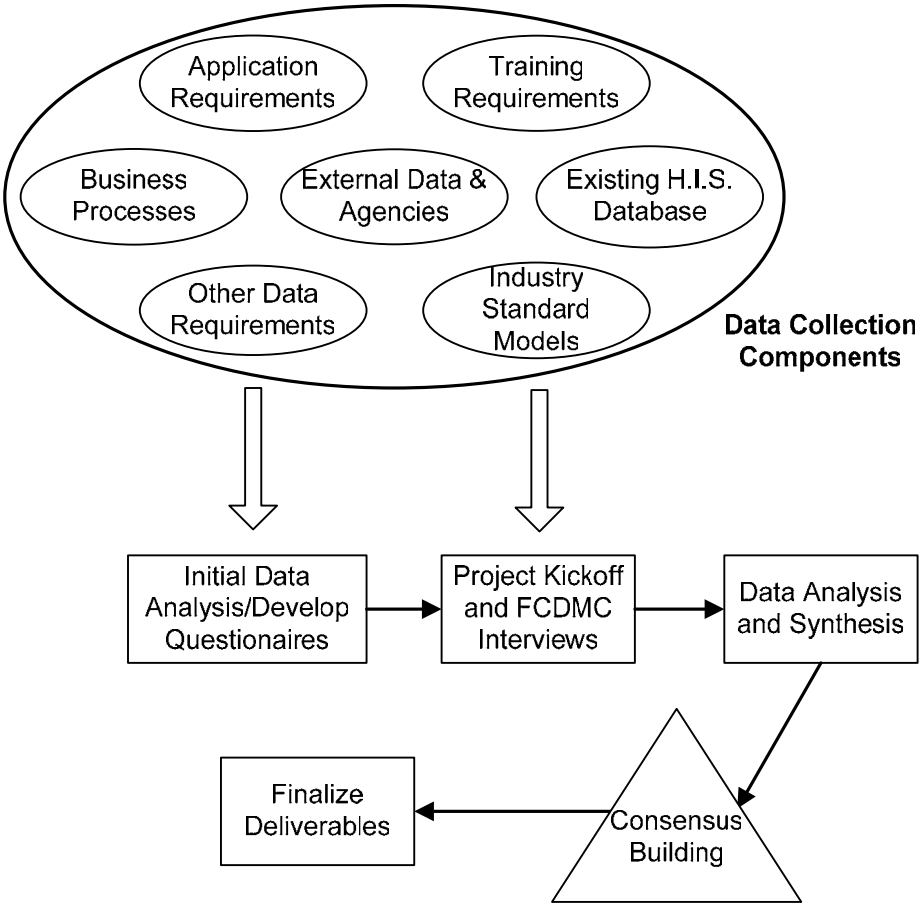
- *Application Requirements*
  - *Evaluate functional, performance, and security requirements, for existing and anticipated applications;*
  - *Evaluation potential enterprise applications and COTS applications (e.g. CMMS); and*
  - *Document requirements.*

- *Training Requirements*
  - *Evaluate current staff skill levels and needs; and*
  - *Document preliminary training needs.*

- *Industry-Standard Model Analysis*
  - *Review industry standard models and requirements for use/integration (ArcHydro, DFIRM, DCS, Unetrans, SDEFIE, etc.).*

There is considerable overlap within the analysis outlined above. For example, many of these steps require interviews with District staff. We will combine the functions of these interviews so that they are comprehensive (e.g. a staff member will be simultaneously interviewed about business processes, data needs/unmet requirements, and application requirements). In addition, these analytical steps are not necessarily sequential as shown here. Our chronological approach to accomplishing the needs assessment is outlined (below) and diagrammed (on the following page), and then described in detail:

1. *Initial Data Analysis/Develop Questionnaires;*
2. *Project Kickoff and District Staff Interviews;*
3. *Data Analysis and Synthesis (Prepare Draft Deliverables);*
4. *Consensus Building; and*
5. *Finalize Deliverables.*



Needs Assessment Workflow

2.1.1 INITIAL DATA ANALYSIS/DEVELOP QUESTIONAIRES

The first step in the needs assessment will be to evaluate the existing H.I.S. database for design, content, and supporting infrastructure. Much of this has already been documented in the "Data Delivery Specifications for the Hydrologic Information System". Our review will be informed by a thorough analysis of this document, as well as a review of the 'live' data (to be provided by FCDMC to Dewberry at the start of the project). We recognize that there are likely to be discrepancies from, and enhancements to, the live data that are not reflected in the H.I.S. document. Our review of the live data will serve to uncover these issues. We will inventory and catalog the data holdings and create a Draft Data Inventory Matrix and a Draft Data Migration Plan.

A particular focus of all of the data inventory components of the needs assessment will be the identification of FCDMC's mission critical data layers. These are spatial data layers that must remain in service during the migration process, and are continuously updated. These will be handled differently during the migration process, as described in the data migration section below.

Concurrent with the evaluation of the H.I.S., we will also inventory, evaluate, and recommend other non-spatial data that might be incorporated into the geodatabase. These results will also be included in the Draft Inventory Matrix. This evaluation will be preliminary, and will be finalized once we interview FCDMC's staff in the next step.

We will also inventory spatial datasets from outside agencies as part of this initial task, and recommend measures for accessing and/or integrating those spatial data holdings while minimizing data duplication. We anticipate that FCDMC will designate those agencies that they wish to be included in this evaluation.

The final step in this task will be to develop comprehensive questionnaires that will be used during the interviews with FCDMC. In general, these questionnaires will cover topics such as:

1. Business Processes

- *a. What are the key business processes performed by FCDMC (focusing on those processes that require digital data, and in particular, geographic data?)*
- *b. How are these data currently input, accessed, manipulated, analyzed, managed, stored, and output, throughout each business process?*
- *c. What staff member(s) perform the business processes?*
- *d. What hardware, software, and training are required?*
- *e. What are the underlying constraints or drivers of the business process (e.g. a required response time to a request, a particular report that needs to be produced, etc.)*
- *f. Are there additional business processes that could, or should, be implemented?*
- *g. What are the data requirements for those business processes?*

2. Other Data Requirements

- *a. Are there data needs that are not currently met by FCDMC's business processes and data collection and management protocols? (Note that this component of the questionnaire isclosely related to the business process analysis)*
- *b. Are there non-spatial data that are currently managed and maintained by FCDMC, that are NOT part of the current GIS data model?*
- *c. Are there spatial data that are managed and maintained by outside agencies that should be integrated with FCDMC's new geodatabase? (Will require interviews with those outside agencies).*
- *d. What integration options are viable? (E.g. mirrored databases, dynamic periodic updates, disconnected editing, web services integration only, etc.)*
- *e. How can Maricopa County's street centerline data be integrated? How will it be maintained and updated once integrated? Are there issues such as topological integration, geometric network construction/maintenance, and linear referencing event themes, that must be considered?*

3. Application Requirements

- *a. What applications currently utilize geographic data?*
- *b. How are these data utilized? What components are editable vs.read-only?*
- *c. How are these data updated through the application(s)?*
- *d. What functions do the applications perform?*
- *e. What performance and security requirements must be met (number of users, speed of response, editors vs. viewers, vs.administrators, etc.).*
- *f. Are there applications that could be implemented that are not yet in place? What are the functional/performance/security requirements for these applications?*

4. Training Requirements

- *a. What is the skill level of FCDMC staff with ArcGIS, ArcSDE, and geodatabase design and editing?*
- *b. What are the specific needs of FCDMC's staff, particularly as they pertain to FCDMC's various departmental and programmatic goals and missions?*

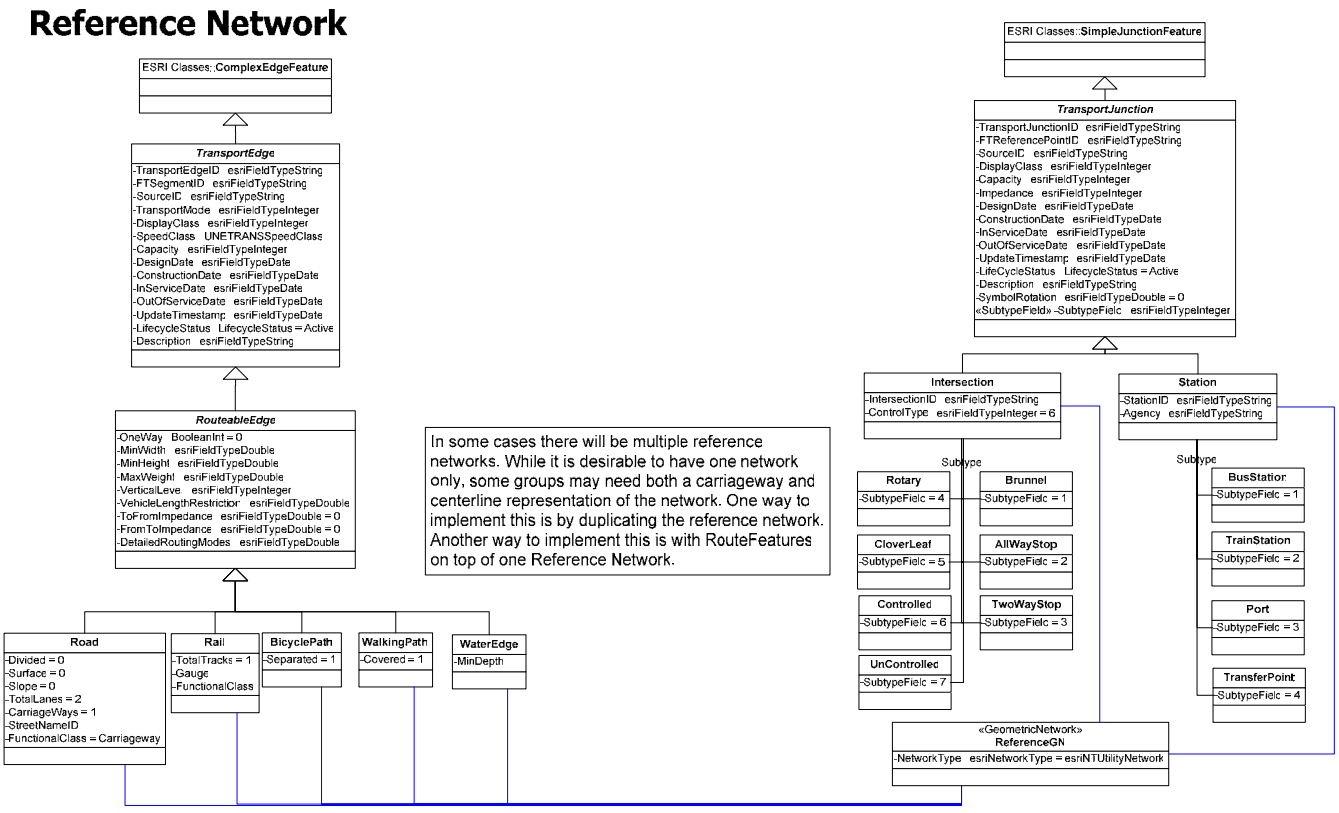
The overarching purpose of these questionnaires will be to drive the design of the geodatabase. Existing and future needs, from both a business process and application standpoint, will be captured through these questionnaires. As noted above, these questionnaires will also cover data integration from non-District agencies, as required by the RFP.

These questionnaires will be provided two weeks prior to the Project Kickoff and District Staff Interviews task, so that District personnel will have the opportunity to review and prepare comments. At this time, we will also ***propose an interview schedule*** *of FCDMC's staff in order to ensure that the correct individuals will be available, and to minimize the impact on business operations.*

2.1.2 INDUSTRY STANDARD DATA MODELS & REQUIREMENTS

Prior to the project kickoff and interviewing phase, we will also evaluate existing industry standard data models and requirements. For example, we recognize that FCDMC is required to output data in both FEMA DFIRM standard, and FEMA Data Capture Standard (DCS) formats. We have unique experience with both of these standards; our Design and Implementation Team Leaders (Sue Hoegberg and Cynthia Crouch) were co-authors for these respective standards. We further recognize that these standards will be upgraded to geodatabase format at a later date; our solution will be developed with this future pathway in mind, positioning FCDMC for a smooth ***future migration to DCS and DFIRM data exports in geodatabase format.***

Both DFIRM specifications and DCS will be evaluated in detail to determine how they might influence the final data model. We will also examine models such as ArcHydro, and Interface Data Models such as HEC-RAS and GeoRAS, as well as other Industry standard models for transportation (e.g. Unetrans) and the National Institute for Standards and Technologies (NIST)-approved Spatial Data Standards for Facilities Infrastructure, and the Environment (SDSFIE).



Unetrans Geodatabase Model - Base Reference Network (A possible input to FCDMC's model development)

CLARIFICATION

Will Dewberry gather input from local, private sector firms and would this influence the design of the geodatabase?

Dewberry has included time in our proposal to meet with outside agencies so that we can uncover any requirements that might impact the geodatabase design. We will work with FCMDC to identify all the stakeholders that might need to be interviewed as one of our first steps in the information needs assessment.

If FCDMC has determined that local, private sector firms can offer input that will be valuable to the design process, then we will certainly include them in the interview process. Dewberry offers, as a preliminary approach, to consult with three such local firms to solicit their input. Should FCDMC wish to expand this pool of local firms, Dewberry would be happy to work with FCDMC to include whatever inputs that FCDMC feels are necessary to incorporate.

The information that is documented as a result of consulting with these firms will be part of the needs assessment, and will influence the geodatabase design as appropriate (and only with full concurrence by FCDMC).

2.1.3 **PROJECT KICKOFF AND DISTRICT STAFF INTERVIEWS**

Once the initial data analysis has been conducted, and we have developed the draft questionnaires, we will begin the Needs Assessment Task by holding a Project Kickoff Meeting. This meeting will serve several purposes. First, it will provide an opportunity to review and confirm the scope, schedule, and deliverables of this project with FCDMC. It will also be used to define the acceptance criteria of all the deliverables. Establishing the acceptance criteria will align Dewberry's and FCDMC's expectations, and should expedite delivery acceptance throughout the project. This meeting will be held at FCDMC's offices.

This meeting will also be a working session in which the questionnaires described above will be reviewed, and alterations or recommendations required by FCDMC will be made. These changes will be incorporated immediately, and interviews of District staff will begin the next business day. We will propose a schedule of interview candidates two weeks in advance to ensure that the impacts on FCDMC's operations are minimized.

We anticipate that a sampling of both production and management staff from each of FCDMC's departments will be interviewed (again, utilizing the finalized questionnaires). We will track and log all responses with our electronic questionnaires. Those business processes that must be diagrammed will be immediately captured in Visio (typically UML use-case or sequence diagrams) to ensure that they are preserved, and can easily be augmented and transmitted. The interviews will be conducted over a period of 5 consecutive business days, and will be performed entirely onsite at FCDMC's offices, and at other relevant Maricopa County agency offices.

Included in our interview process will be a visit with the Maricopa County Department of Transportation (DOT) & Recorder/Elections Department. We will evaluate the structure of the street centerline data maintained by DOT, as well as other relevant geospatial data holdings that might need to be integrated into the new geodatabase. These requirements will be carried forward and will influence our design (particularly the design of the transportation components).

It is important to note that our sample questions are not confined to the data inventory aspect of performing a needs assessment. Our past experience tells us that the analysis of business processes and software applications (both existing and proposed) is crucial to the success of a data model development and implementation project. These requirements must be uncovered and documented from the outset, so that the data model can be developed to meet current and anticipated process and application requirements. Our analysis of the applications that

will utilize the geodatabase will be finalized and documented in the last task of this project as a series of application recommendations, as per the requirements of FCDMC's project.

2.1.4 DATA ANALYSIS AND SYNTHESIS (PREPARE DRAFT DELIVERABLES)

The draft deliverables will be prepared once the data collection phase has been completed. We will synthesize all findings, and prepare three documents as part of this task:

1. ***Needs Assessment Document*** *(including matrix of requirements and UML business process models)*
2. ***Data Inventory Matrix*** *(drafted during the initial research phase)*
3. ***Preliminary Data Migration Plan*** *(drafted during the initial research phase)*

2.1.5 CONSENSUS BUILDING

The consensus building phase ensures that all stakeholders in the geodatabase design and implementation process have their concerns properly represented. Consensus building will occur as a one-day workshop, facilitated by Dewberry's project manager. During this workshop the key components of the needs assessment, data inventory matrix, and data migration plan, will be reviewed, and agreement will be reached through consensus building exercises where necessary.

2.1.6 FINALIZE DELIVERABLES

The Needs ***Assessment Document, Data Inventory Matrix,*** *and* ***Preliminary Data Migration Plan****, will all be finalized upon completion of the consensus building phase.*

CLARIFICATION

In addition to infrastructure benchmarks, what other "performance criteria" might be considered in a functional assessment of an enterprise-scale geodatabase?

Dewberry's approach includes performance testing of the geodatabase during prototyping, and also as part of our final testing of the geodatabase migration. Our test results will be documented in our Final Schema Test Results document.

It is our intent to measure not only the performance of the new geodatabase platform from a speed standpoint, but also issues such as functionality and robustness. A functionality assessment of the geodatabase, at both the prototyping stage and geodatabase migration stage, will include:

- *Functionality (does the geodatabase operate as intended? Do queries function correctly, and return accurate results?)*
- *Robustness (are there aspects of the geodatabase prone to faults or failure? Is the geodatabase able to run and operate with minimal down-time?)*
- *Security (has security been appropriately implemented for the geodatabase? Have common security issues been addressed? Are view-only users appropriately prevented from editing?)*
- *Performance (are queries, edits, and displays of data performing as expected from speed standpoint?)*
- *Interoperability (is the geodatabase designed and implemented in a manner that will allow for easy integration with external data, and integration with external enterprise applications?)*
- *Scalability (is the geodatabase designed with future expansion in both volume and complexity in mind?)*

All of these tests will be performed formally, documented, and provided as part of our test results.

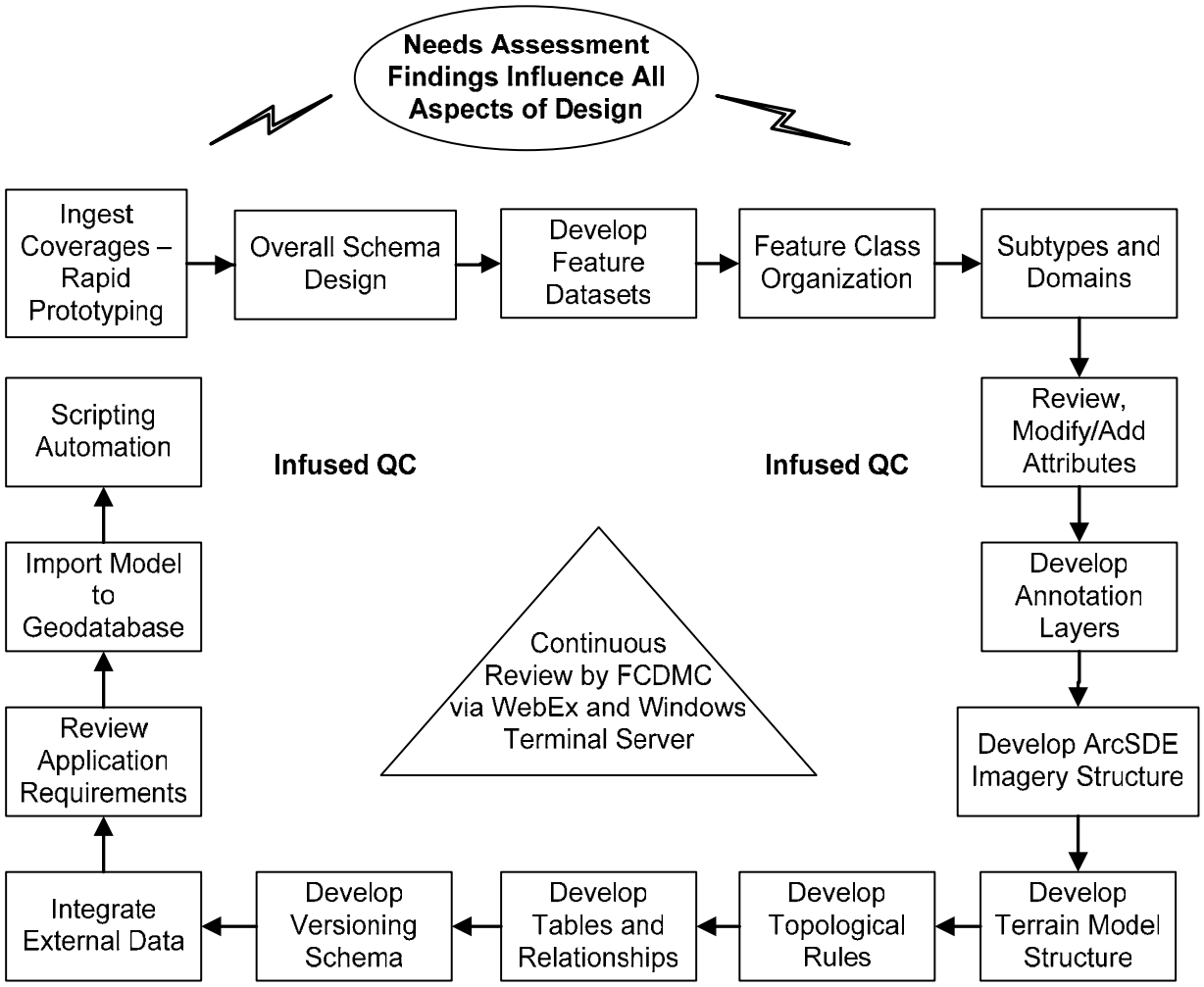
Dewberry will also be performing a vertical datum conversion of FCDMC's DFIRM database while this migration to a geodatabase environment is in process. We plan on utilizing the new infrastructure as soon as possible in our conversion efforts. Dewberry will also be an end-user, like FCDMC, of the data set and our own work and project will be impacted by poorly performing FCDMC geodatabases or non-functional datasets and linkages. We therefore have a vested interest in developing a geodatabase that performs well so that both projects can be successful.

THE REMAINDER OF THE TASKS AND DELIVERABLES WILL BE CONTRACTED ON A REQUIREMENTS BASIS AND AS FUNDING IS AVAILABLE.

2.2 **GEODATABASE DESIGN:**

Design the optimal SDE geodatabase data model, including rules and exceptions, domains, version control, etc. to provide the necessary data management, including data automation, analysis, and delivery for the District. At minimum, the geodatabase design shall include:

Our approach to the geodatabase design task will be informed and guided by the needs assessment task. Again, this needs assessment will include not only a data matrix, but also recommendations for accommodating DFIRM and DCS standards, as well as utilization of models such as ArcHydro. These recommendations will be woven throughout our design subtasks. We will partner with FCDMC throughout the development effort, reviewing key milestones of the design via our WebEx and Windows Terminal Server (WTS) collaboration tools. The subtasks for development are diagrammed and described in detail.



Geodatabase Design Workflow

2.2.1 INGEST COVERAGES – RAPID PROTOTYPING

FCDMC's current GIS database represents data and functional requirements that are fairly mature. We can leverage these existing requirements to perform rapid prototyping of the initial geodatabase data model, rather than starting completely from scratch. We will extract the current structure of the existing coverages and import that structure into Visio so that the database can be modeled using standard UML modeling tools. This first step is effectively reverse-engineering the existing GIS database into the data modeling environment to form the modeling foundation. Once it has been reverse-engineered, we can make the revisions that are necessary to turn the legacy coverage-based GIS database into a geodatabase that fully leverages the advantages of ArcGIS/ArcSDE 9 technology.

2.2.2 SCHEMA DESIGN

The schema design step is the philosophical determination of what the final geodatabase will look like. Will it be a geodatabase that closely mirrors the existing coverage structure? Will it be a geodatabase that borrows from many different requirements (e.g. existing coverage database, DCS and DFIRM standards, and ArcHydro), and thus does not really resemble any one input? Or will it be a model that closely mirrors an industry standard data model such as ArcHydro? These decisions can only be made as a consequence of the needs assessment. Whatever that decision is, it will drive the overall vision of the geodatabase, and it will determine how the steps described below are carried out. It should be noted that our approach to the geodatabase design, first and foremost, is to ensure ***0% data loss during migration****. Existing coverages represent a substantial investment, and we will retain the value of that investment by capturing all existing data in the new model.*

2.2.3 DEVELOP FEATURE DATASETS

Once we have completed ingesting the existing data model, and determined the overall design direction, we will begin designing the nuts and bolts of the new geodatabase, again using Visio. We will have already made a 'first pass' at the feature classes that will exist in the geodatabase as part of the first step in the migration project (the rapid prototyping described above). We will continue the development process by defining the feature datasets of the geodatabase based on our known schema design. The Feature Datasets form the basic structure of the geodatabase, and will encapsulate sets of functionality and relationships. For example, feature classes that have some sort of explicit topological relationship (e.g. Bridges and Street Centerlines) will be structured so that they are stored in the same feature dataset. A feature dataset in a geodatabase acts as a container for feature classes that share the same projection and spatial domain, and feature classes that reside in a feature dataset can participate in topology classes together. These feature datasets will form the first layer of organization for FCDMC's new geodatabase. It is likely that some of these feature datasets will be similar to FCDMC's current categories, as listed below:

- *Administrative;*
- *Cartographic Detail;*
- *Control;*
- *Cultural Resources;*
- *Data Quality Tables;*
- *Floods and Floodplains;*
- *Infrastructure;*
- *Natural Environment;*
- *Property;*
- *Water; and*
- *Water Quality.*

However, some of these will change, as the new design will also be dictated by the need to store feature classes in the same feature datasets when they share topology rules or participate in geometric networks together. In addition, some of these categories (e.g. cartographic detail and data quality tables) can likely be seamlessly integration in the geodatabase, rather than functioning as distinct categories.

2.2.4 FEATURE CLASS ORGANIZATION & MERGE/SPLIT OF FEATURE CLASSES

Once the feature datasets have been defined, we will organize the feature classes that were rapidly prototyped into feature datasets, in accordance with the requirements identified in the needs assessment. Feature classes that are edited by certain classes of users, or that participate in topology classes, for example, will reside in the same feature dataset. At this stage feature classes will also be merged and/or split depending upon the user requirements previously defined. This step is recommended because the use of feature classes and subtypes, as well as user requirements, may dictate that certain coverages may be better managed if combined into a single feature class. An example of this might be the combination of FCDMC's Floodplain coverages (Corps Zone, FCD Zone, FEMA Zone, and Hazard Zone) into a single feature class, with subtypes to differentiate between them. Conversely, some input shapefiles or coverages may be better split into multiple feature classes. We will review each of the feature classes and recommend these design changes where appropriate.

2.2.5 DEVELOP SUBTYPES & DOMAINS

Feature classes are fundamentally different from coverages in many ways. One way that they are different is that feature classes allow users to create and use subtypes to manage and organize data within a layer. A subtype is simply a classification within a feature class that differentiates one category of feature from another. An example might be categories of Primary and Secondary roads within a Street Centerline feature class. Subtypes can greatly facilitate the display and management of feature classes. We will make design recommendations for subtypes as appropriate, and document these recommendations in the geodatabase Visio model.

Another major difference between shapefiles and geodatabase is that a geodatabase can use attribute domains to enforce consistency and quality when entering and managing attributes in feature classes. Domains can be range domains (a range of valid numbers for a numeric field) or enumerated text domains (a list of valid values for a text field, such as Arterial, Secondary, and Private, for a street attribute). From a user standpoint, domains represent a major difference between the structure of a coverage, and their proper development is crucial to the overall effectiveness, usability, and quality of the geodatabase. We will develop these domains by ingesting the attributes of existing coverages and INFO lookup tables, and extracting unique values and ranges to form domains. We will document them within the Visio data model. These domains will be modified and added to as necessary, in order to accommodate the new requirements identified in the Needs Assessment.

2.2.6 REVIEW/MODIFY/ADD ATTRIBUTES

The development of attribute domains will lend itself to a review of all feature class attributes. For example, it may be desirable to convert text fields from source coverages to numeric fields in the target geodatabase, or text fields to date fields, depending upon the type of data that are stored in these fields. We will develop these changes as appropriate.

2.2.7 DEVELOP ANNOTATION LAYERS

One of FCDMC's greatest challenges in this migration effort will be in the migration of existing annotation. ArcGIS/ArcSDE 9 provides significant advantages over annotation

handling and storage as compared to the coverage environment, and there are even large differences between how annotation is handled between ArcGIS 8.3 and 9.

Dewberry recommends the migration of the annotation into annotation feature classes that are feature-linked. ***Feature-linked annotation*** *is the linking of an annotation feature to the attribute (or attributes) of a field in the feature class to which the annotation corresponds. For example, a road text annotation feature may be linked to the attributes of a road segment. If the road name attribute of the road segment is altered, the annotation text will update accordingly. Feature-linked annotation is a powerful way to enforce quality and integrity between the geodatabase and the cartographic elements that are used to represent that geodatabase. The annotation schema will be documented in Visio.*

2.2.8 DEVELOP ARCSDE IMAGERY STRUCTURE

We also recognize that FCDMC wishes to store all digital aerial photography directly in the geodatabase. There are two ways that this can be done. Images can be stored as collections of images called raster catalogs, or they can be stored as raster mosaics. Both store the imagery directly in ArcSDE. For FCDMC's needs, we are proposing ***single raster mosaics*** *for each of FCDMC's photographic datasets (totaling 2.25 terabytes). Raster mosaics allow users (and applications) to retrieve and view the entire raster dataset as one seamless layer, and a raster mosaic embedded in ArcSDE offers considerable speed advantages over raster catalogs, because the spatial indexing is handled entirely by ArcSDE. We also recognize that the DRQ's may require different handling, depending on whether map collar information is to be retained. We will review these imagery files, propose the final imagery design structure, and document this design in the Visio model.*

2.2.9 DEVELOP TERRAIN MODEL STRUCTURE

The storage of terrain data in geodatabases has not kept pace with the storage of vector and raster data. There is no current solution for storing terrain data in a geodatabase; however, the release of ArcSDE 9.2 (anticipated in the 2nd quarter of 2006), will change this circumstance. In the ArcSDE release of 9.2, very large terrain datasets can be tiled and stored in ArcSDE. Dewberry has participated in some of the ***beta testing*** *of this new ESRI capability, and although it is not perfect, it offers a solution that was previously only possible to implement through closed, proprietary solutions. We recommend pursuing this as an option to storing FCDMC's terrain data, and we will document this recommendation in our data model.*

We will also evaluate the storage of FCDMC's ASCII-based coordinate elevation data. These can be converted to point feature classes in the geodatabase, or they can be held outside of the geodatabase. We are assuming at this time that they will be included in the geodatabase as feature classes, and we have planned our conversion effort accordingly.

CLARIFICATION

You mentioned that you would use ArcGIS 9.2 to handle terrain data structures. Please elaborate on how this structure will handle LiDAR data, mass points and break lines, tins and slope grids from different mapping projects.

FCDMC has not only current LiDAR data, but also historical terrain data sets to manage in a new structure. We believe that the new ArcSDE 9.2 terrain data feature class will offer FCDMC significant advantages, but before committing to this implementation course, we will need to understand how terrain data is used at FCDMC and which formats would be most appropriate.

ArcGIS 9.2 will implement the new Terrain Dataset class. This feature class lets you work with terrain datasets in an "image pyramid" type scheme. As you get to finer resolutions, the Terrain feature class displays a hierarchy of products through DEM / DTM / Contours / then raw LiDAR points and breaklines. Coarser grids are displayed at the scale of whole counties, and mass points would be displayed when a user is zoomed into detailed scales such as those needed to examine individual cross section profiles. Multiple terrain surfaces can be drawn for 1 location, so you could see the DEM/DTM/contours, and mass points for a locale at one time. ArcGIS 9.2 has also been optimized for display of millions of points for faster drawing speeds. It should be noted that terrains from different sources or time periods would probably be stored in separate terrain datasets so as to avoid mixing apples with oranges, and so they can be appropriately and fully documented with metadata.

This is the first time a Terrain feature class is being offered by ESRI and it is still unclear as to whether or not it has the capabilities to build DTMs on-the-fly from the LiDAR mass points. We propose to set up test terrain feature classes in ArcSDE 9.2, and load some sample terrain datasets, as part of our geodatabase design and prototyping. We will conduct a live demonstration with FCDMC to help us determine if the terrain data structure is indeed suitable. Dewberry is able to perform this test using our Windows Terminal Server environment, and deliver the live geodatabase over the web to FCDMC. Furthermore, because of our Enterprise License Agreement with ESRI, we have all the software required to perform this testing; there will be no spin-up time or additional software purchases needed for us to demonstrate this capability to FCDMC.

Dewberry is aware that other vendors are exploring the storage of LiDAR data in ArcSDE. For example, Dewberry has worked with AmberCore Software (makers of iQ LiDAR software); AmberCore is currently investigating how LiDAR might be stored in ArcSDE (a solution that would NOT use the new terrain datasets).

2.2.10 DEVELOP TOPOLOGICAL RULES

ArcGIS/ArcSDE 9 geodatabases are fundamentally different from shapefiles and coverages when it comes to the handling of topology. Topology is much more robust in a geodatabase (i.e. there are many more topological rules that can be defined) and geodatabase topology supports more flexible and more varied workflows. However, it can also be difficult to use if the proper training is not supplied, and if the geodatabase is set up or managed incorrectly. We propose to set up topology classes in the geodatabase for key feature classes such as BFEs and Flood Zones so that the proper spatial relationships between these layers can be maintained. Rules such as "BFEs must not intersect" and "BFE endpoint must be

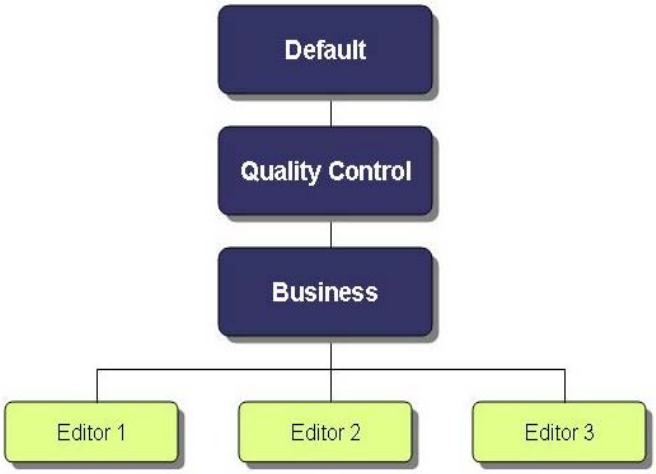
covered by boundary of a 100-year flood zone) will be created and saved as part of these topology classes. We also propose to restrict the editing of these layers to key staff that are properly trained. Editing will be restricted by setting up appropriate user permissions in SQL Server. These topological rules will be graphically depicted in the Visio model, and a topology rule file (.rul) will be provided for each topology class during delivery.

2.2.11 DEVELOP TABLES AND RELATIONSHIPS

We will also develop any stand-alone tables that might be needed by the geodatabase. This step will give us the opportunity to account for any existing standalone tables, or new user requirements that have been identified. These tables will be developed and documented in the Visio model. We will also establish relationships in the geodatabase at this time. We note that the existing coverage model has a number of relationships, especially for lookup tables. Many of these will be converted to domains, but others will remain as separate, related tables. There will also likely be many additional relationships in the geodatabase, as dictated by user requirements and applications of industry standard models.

2.2.12 EVALUATE VERSIONING REQUIREMENTS, DEVELOP VERSIONING SCHEMA

One of the major steps in designing a geodatabase is the creation of a Versioning structure that effectively meets the needs of FCDMC. Versioning is a way to control and validate database edits before 'posting' them to the business version of the database. It is also a way to segregate the edits (and possibly mistakes) of one user from other users. A versioning structure that we have found to be successful is shown here.



Possible ArcSDE Versioning Schema

The parent version of the ArcSDE geodatabase is always "DEFAULT". This version will be Protected (only the SDE administrator will be able to alter it). This will also ensure that no schema changes are made by unauthorized users. There will be a QUALITY CONTROL version that is a child of the DEFAULT version; this version will be controlled by the database administrator, who will review and approve changes before reconciling and posting to the DEFAULT version.

There will also be a "BUSINESS" version that is a child of the QUALITY CONTROL version; this will be the primary geodatabase that most users will see and use. This BUSINESS version will also have user-specific versions that are spawned and controlled by individual users that are authorized data editors. These users will edit these user-specific versions, then reconcile and post back to the BUSINESS version on a regular basis.

Versioning schemas are very flexible; there are dozens of ways to structure a solution, and this is only one. We will decide upon the most appropriate structure as a result of the needs assessment, and describe it as notes and diagrams in the Visio model.

2.2.13 INTEGRATE EXTERNAL DATA

One of the key requirements of this development effort is the integration of external datasets from other agencies. These datasets must be incorporated, but must minimize manual intervention and duplication of data. This integration may take many forms (e.g. automated updates from remote servers, possibly the use of web map services, etc.); we will determine the best methodology for integration on a case-by-case basis.

2.2.14 REVIEW APPLICATION REQUIREMENTS

The final step in the geodatabase design/modeling effort is to review the model against the application requirements uncovered in the needs assessment. It should be noted that

this step is really woven throughout the entire development process, and we will be constructing a model throughout that is 'aware' of the application requirements. However, it is at this final stage that we will ***refocus on the application requirements*** *and confirm that the geodatabase design meets those requirements.*

2.2.15 IMPORT MODEL TO GEODATABASE

The culmination of this extensive modeling effort will be comprehensive geodatabase model stored in Visio. Visio will provide an excellent way to visualize the overall structure of a geodatabase, and will allow the both FCDMC's management and technical personnel to easily review and comment upon the details of the geodatabase. However, the Visio development environment is imperfect. Visio does not allow for the definition of a spatial reference for spatial features, and it is limited in the handling of more advanced class creation (e.g. modeling of annotation feature classes). We will therefore use the ESRI Geodatabase Designer tool to export the Visio UML model to Extensible Markup Language (XML) format. Once it is in XML format, we will make the necessary edits to complete the model. These alterations or deviations from the base Visio UML model will be handled by documenting the changes using notes in the Visio model, and class placeholders where appropriate. This will ensure that the UML model fully captures the structure of the final geodatabase, and can be used as a comprehensive reference.

2.2.16 SCRIPTING/AUTOMATION

It is our recommendation that FCDMC utilize the off-the-shelf capabilities of the geodatabase, ArcSDE, and ArcGIS, wherever possible, as this will reduce the maintenance overhead for customized code and solutions. However, such customization may be unavoidable, especially where the geodatabase does not provide for specialized behavior that might be desired. In these cases, Dewberry will develop the customized code and provide it along with the Visio documentation, the XML documentation, and the topology rule files. It is anticipated that customization of this type will likely be database triggers in SQL to automate updates, as well as possibly the development of customized classes in ArcObjects.

2.2.17 COORDINATION AND DELIVERY

It is Dewberry's intent that this data model be developed in close coordination with FCDMC. Our schedule calls for weekly demonstrations and reviews of the modeling process via Windows Terminal Server and WebEx, so that FCDMC will always be kept up to date and informed as the progress of the development moves forward. Additional meetings and demonstrations may also be scheduled, if key development milestones are reached, or major decisions by FCDMC are needed. This approach will ensure that we remain on track, and adhere closely to the requirements of FCDMC. There will be no surprises during the development, because we will partner with FCDMC throughout the project.

Our final deliverables for this task will be:

1. ***Preliminary Interchange File*** *(export of the Visio geodatabase model to an XML geodatabase exchange file);*
2. ***Preliminary Design Documentation*** *(Visio geodatabase design and ancillary documentation); and*
3. ***Automation Source Code*** *(any automation or database scripts required to augment/complete the geodatabase design).*
4. ***Preliminary Operating Procedures*** *(procedures for geodatabase maintenance and data maintenance, and procedures for running automation code)*

CLARIFICATION

If errors or anomalies are detected in FCDMC's datasets prior to migration, what party will be responsible for the clean-up?

*Dewberry **expects** to find some errors or anomalies, and we have planned for and included this as part of our price and approach. Errors or anomalies that require a moderate amount of clean up, or that can be fixed through automated means with a moderate amount of scripting, will be handled by Dewberry as a part of the migration project, and will not impact the scope or schedule in any way. We accept that such anomalies are inevitable and must be dealt with during a migration project such as this one.*

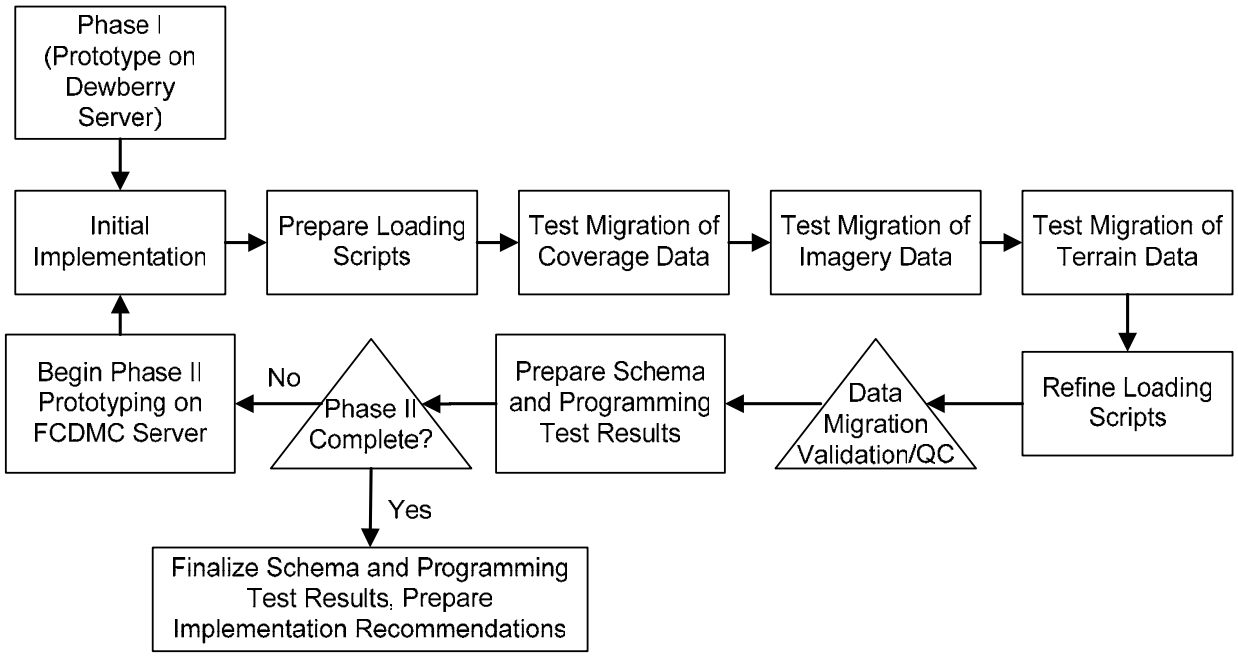
We anticipate, for example, that the migration of FCDMC's existing annotation from coverage format to annotation feature classes will likely require some manual and automated processing in order to ensure that the final geodatabase accurately represents the source data. We have extensive experience migrating annotation from ArcInfo and CAD formats to geodatabases, and we have found that annotation in ArcGIS 9 has unusual behavior that must be accounted for. Our experience with these types of errors will allow us to quickly identify and resolve most errors and anomalies without difficulty.

Pre-existing anomalies or errors in the source ArcInfo coverages, terrain data, or raster data, that will require significant manual editing or scripting, must be handled differently. We will handle such issues on a case-by-case basis, in close coordination with FCDMC, to ensure that expectations are met, and that the final product is as accurate and complete as possible

2.3 PROTOTYPE DEVELOPMENT:

Conduct performance testing on a trial implementation of the proposed geodatabase schema.

The prototype development task will be a two-pronged effort. We will first implement a prototype of the geodatabase on a Dewberry-hosted machine, test it by migrating sample datasets, and document both acceptance (viability) criteria and a preliminary data migration plan. The second component of this effort will be prototype implementation of the geodatabase on FCDMC's server, again using sample datasets. Our workflow is diagrammed below.

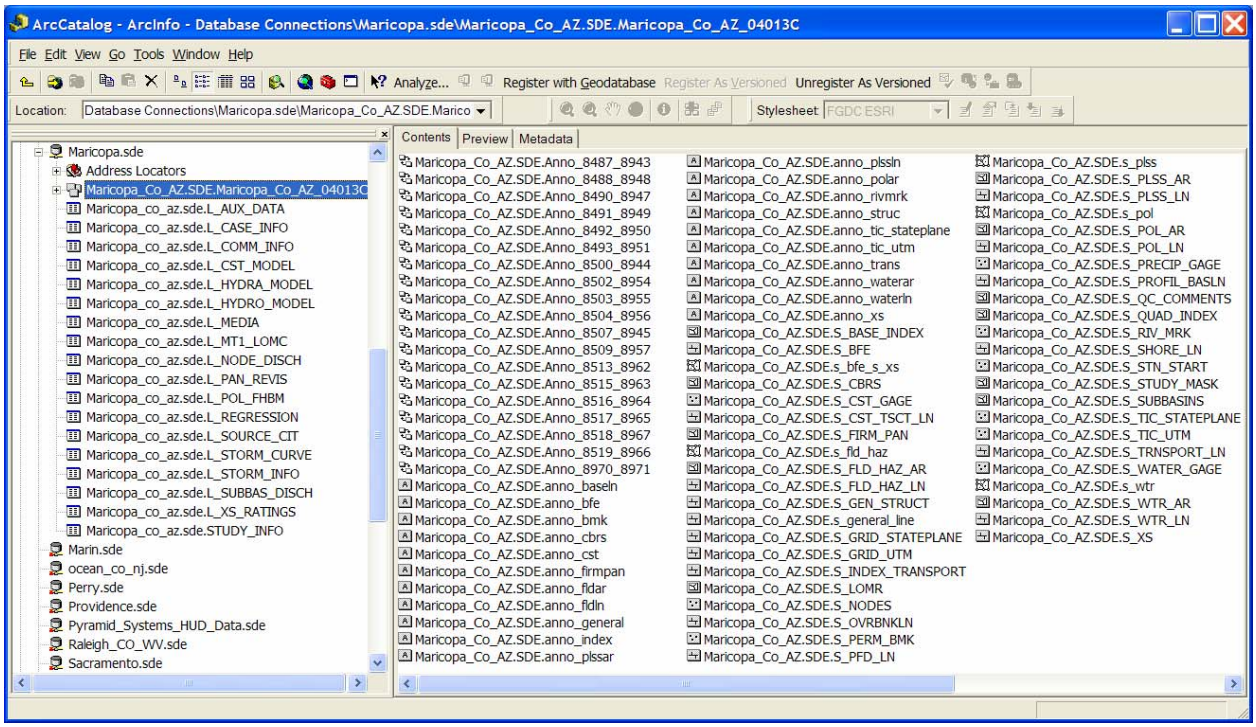


Prototype Implementation Workflow

*The first phase of the prototype will provide **maximum speed and flexibility for testing** and tweaking schema design and implementation procedures. This internal Dewberry implementation will be completely open to FCDMC. We will use Windows Terminal Server (WTS) web-based technology to allow FCDMC to log in to Dewberry's server and view the geodatabase just as though they were sitting at a Dewberry machine in a Dewberry's office. In this way, FCDMC will be able to immediately see the changes and impacts that will be implemented for the Prototype, all in a living geodatabase environment, rather than viewing a static Visio model.*

2.3.1 INITIAL PROTOTYPE IMPLEMENTATION

*The first step in implementing the prototype will be loading the XML schema into an ArcSDE database **on Dewberry's enterprise class ArcSDE server** ("Potomac"). Potomac utilizes SQL Server enterprise as the RDBMS, so it has an architecture that closely aligns with FCDMC's. We have implemented more than 75 ArcSDE geodatabases in this environment, most of which have been county-wide DFIRMs. We already have a Maricopa/FCDMC geodatabase set up in this environment, ready to begin prototyping.*



We have already implemented a Maricopa geodatabase on our server.

We will implement the versioning structure, topological rules, and any customized code, as defined by the Visio diagram and ancillary documentation. The geodatabase will be an empty shell at this stage.

*The next step will be to perform a test migration of some of H.I.S. **coverage-based** data into the ArcSDE geodatabase, as well as test migrations of **imagery and terrain** data. We recognize that there are two types of data that need to be loaded into the data; these are mission-critical data layers, and non-mission critical layers. Mission critical data is data that is continuously updated, and cannot be taken out of service during normal business hours, or data that cannot be taken out of service for any length of time at all. Non-mission critical data, by contrast, is fairly static (e.g. administrative boundaries), and therefore does not have to be managed as closely during data migration. That is not to say that these data are of lesser importance, but simply that they can be managed and migrated somewhat differently.*

We will designate, as part of our data inventory matrix, those data layers that are mission critical, and we will perform a test migration of all of these layers in our initial prototype development. Our loading process will have a combination of manual and automated processes, and is more fully described in our geodatabase migration section below. We will also prepare FGDC-compliant metadata for the prototype implementation.

Once we have migrated the sample data, we will perform the following tests, and document the procedures used:

2.3.1.1 Ensure that 100% of features were migrated (by record count);
2.3.1.2 Ensure that projection and datum are correct;
2.3.1.3 Ensure that spatial domain and precision are correct;
2.3.1.4 Ensure that no substantial shift in coordinate locations have occurred (minute shifts in coordinates are unavoidable due to the geodatabase coordinate storage paradigm, but these can be managed at a level that is typical several orders of magnitude less than the mapping accuracy of the data);
2.3.1.5 Ensure the geometry of each layer is correct (point, polygon, line), with no multi-part features except where indicated by the data model;
2.3.1.6 Validate the topology classes, and perform test topological edits to assess the efficacy of the topological rules;
2.3.1.7 Verify linear measurement systems by importing and/or creating test routes and events, and querying and displaying those routes and events.; and
2.3.1.8 Verify attribute migration with 0% loss. (Sort ascending and descending on attribute fields, check for null, zero, and -9999 values where applicable, and verify and validate correct handling of new domain fields and preexisting lookup tables).
2.3.1.9 Conduct performance benchmark testing (speed of data access, display, querying, topological validation, editing, etc.), using performance of old H.I.S. geodatabase as the standard.
2.3.2.10 Ensure that the prototype metadata conform to FGDC standards, and meet FCDMC's documentation standards for content and completeness.

Our internal prototyping will be performed in close coordination with FCDMC. We will produce three documents as a result of this prototyping effort:

1. ***Preliminary Schema Test Results;***
2. ***Preliminary Programming Test Results; and***
3. ***Final Implementation Recommendations – Recommendations for altering the data model and migration plan as a result of the prototype testing. We will make these changes as necessary, and begin preparations for the full data migration.***

Once we have completed these three documents, we will alter the Visio data model and generate the updated XML schema per the recommendations made in the Final Implementation Recommendations document.

CLARIFICATION

In your proposal, you expressed that you would ensure that no substantial shift in coordinate locations have occurred due to the minute, horizontal coordinate shifts that are unavoidable due to the geodatabase storage paradigm. If we intend to have extents that encompass the entire state, will this be an issue?

The ArcSDE geodatabase does introduce tiny shifts in geometry due to the manner in which coordinates are stored. This is because all coordinates in ArcSDE geodatabases are stored as 32-bit integers to aid in storage and to speed processing and display. This means that each geodatabase is divided up into a box that is 2,147,483,648 spatial units on each side, independent of the map units chosen. This box is then divided by the number of map units in the spatial domain that the user chooses. The larger the spatial

domain in map units, the lower the precision, (with the precision being the smallest distance that can be digitized between two features or vertices in the geodatabase).

However, with a spatial domain that encompasses the entire state of Arizona, the precision will still be one hundredth of a foot (or 0.01), assuming that Arizona State Plane Central Zone, NAD83, International Feet is used as the projection. We have set up a test geodatabase to show the parameters that might be used, and the resulting precision. Note that these coordinates do encompass the entire State of Arizona, although Arizona is not centered in this extent. We would make sure that Arizona is centered in the final spatial domain created for the enterprise geodatabase. Also note that we have 'snapped' the precision to a base ten number, per ESRI's recommendations.

Dewberry maintains a finger on the pulse of the latest ESRI technology, and we have learned that a 'high-precision' option may be included with ArcGIS/ArcSDE 9.2. We do not yet know the nature of this high-precision storage structure, but it may prove useful for FCDMC's needs. We will explore this option as part of our needs assessment.

The state-wide extent does introduce some problems unrelated to precision. First of all, use of the State Plane Central Zone (where Maricopa County is located), means that features in the south west part of the State will have negative coordinates, which may be undesirable. Second, there is a degree of distortion that is introduced by extending the projection parameters of the Central Zone to include the entire state. This distortion may introduce inaccuracies that are unacceptable to FCDMC.

As part of our needs assessment, we will explore the proper and acceptable use of projections in relation to FCDMC's needs. We may indeed wind up using a single State Plane projection for all of FCDMC's data. It is also possible that we'll offer a solution in which the Maricopa County-specific data are stored in a single projection, while state-wide datasets are stored in a projection that is more suitable to state-wide mapping. We will work with FCDMC to determine these requirements, and we will only implement a solution once we've determined that it best suits your needs.

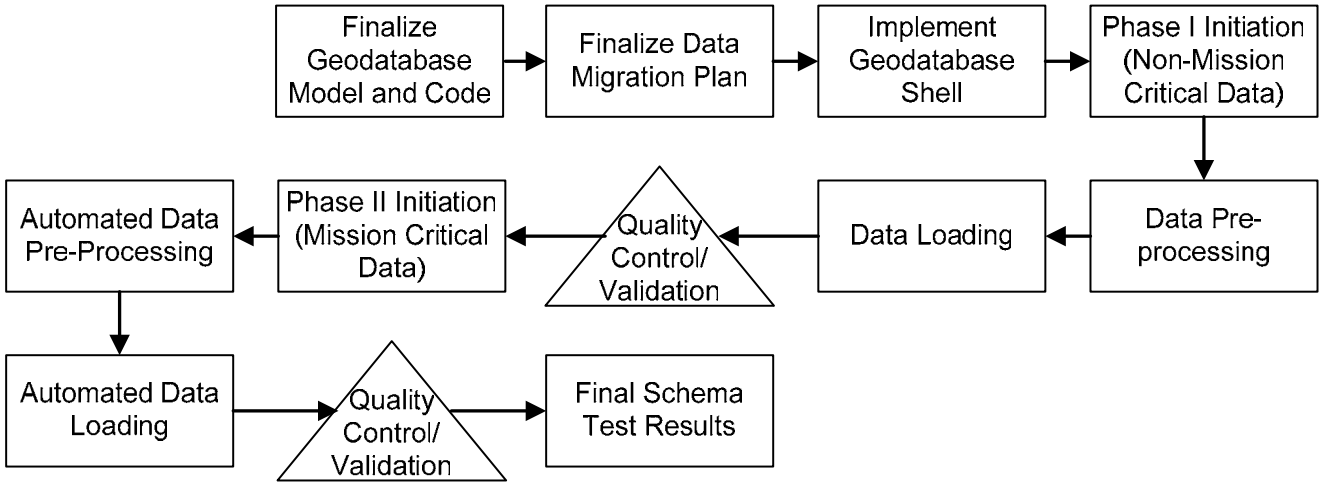
2.3.2 FINAL PROTOTYPE IMPLEMENTATION

We will then perform a second prototype implementation, this time at FCDMC's offices on FCDMC's server. This step will be performed in close coordination with FCDMC to ensure minimal impact to operations. This implementation will uncover the pitfalls and issues that we will confront for the full implementation, and will serve as a ***'shake-down'*** *of our implementation procedures. Included in this test implementation will be all of the mission-critical data layers, including vector, imagery, and terrain datasets, as well as full performance benchmark tests. This will ensure that when the official 'go-live' date arrives, there will be a smooth transition to the use of the new geodatabase. We will revise the* ***Preliminary Schema Test Results****,* ***Preliminary Programming Test Results****, and* ***Final Implementation Recommendations*** *once the final prototyping is complete.*

2.4 GEODATABASE MIGRATION:

Load the entire HIS and other pertinent data into the geodatabase.

The full migration of the existing H.I.S. data to the new geodatabase is a momentous undertaking, and one that will affect many aspects of FCDMC's organization. Careful coordination, transition planning, and quality control, are required to ensure success. Our workflow for accomplishing the geodatabase migration is diagrammed below.



Geodatabase Migration Workflow

Our first step will be to finalize the Visio data model, generate the final XML schema, and finalize any automation code, based on the final prototyping effort performed in FCDMC's offices. The final Visio model, XML schema, and fully documented code will be provided to FCDMC. This satisfies FCDMC's requirement for these deliverables:

1. ***Final Data Model*** *(Visio model, with ancillary documentation);*
2. ***Final Data Model Interchange File*** *(XML geodatabase exchange file);*
3. ***Final Automation Source Code*** *(including code comments and documentation); and*
4. ***Final Data Migration Plan*** *(created as described in the section below).*

Once the model has been completed and delivered, we will proceed with the full data migration task. This is the most time-sensitive and most critical of all tasks. We recognize that this migration MUST be performed in a manner that ensures that FCDMC's business operations are not interrupted. This means that data will be migrated in two phases (Phase I and Phase II), and can only be migrated when all FCDMC's departments and personnel have agreed that data layers that are linked or otherwise spatially associated are ready to be migrated. Phase I will be the migration of the ***non-mission critical data****. Phase II will be the migration of* ***mission critical*** *data. This approach is intended to minimize the impact to FCDMC's business operations by ensuring continuity and minimal loss of data access.*

2.4.1 DATA MIGRATION PLAN

Before beginning Phase I, we will revise the data migration plan produced during the needs assessment, applying all lessons learned during the prototyping phase. The data migration plan will act as the transition plan, laying out the overall schedule for the migration and identifying those mission critical layers that require additional attention and care to ensure that they are not taken out of service. The transition plan will describe how these layers will be handled to ensure minimal impact (e.g. migration during off-hours, migration while keeping the source in service and logging additional edits to carry forward, etc.). The schedule for this ***Final Data Migration Plan*** *will be presented in detail in Microsoft Project. Our specific approach to migration is described below.*

2.4.2 GEODATABASE IMPLEMENTATION

We will begin by implementing the ArcSDE 9 geodatabase on FCDMC's geodatabase server, using the XML schema and topology rule files, as well as any customized automation code. Because this step will have already been tested in the Prototyping phase, it will be smooth and seamless. At this time, we will NOT implement the geodatabase versions. Omitting this step until near the end will allow us to easily batch

load data into the geodatabase without the need to repeatedly reconcile, post, and compress. The geodatabase versioning structure will be implemented once Phases I and II of the data migration are complete.

2.4.3 PHASE I

Data migration is typically an exercise in systematically and thoroughly 'mapping' the source coverage to the target feature class, including mapping source and target attributes. This process is a natural outgrowth of the modeling effort, and it will be greatly facilitated by our reverse engineering of the existing H.I.S. database into Visio. We will be able to graphically depict the linkage between old coverages and attributes and new geodatabase feature classes and attributes.

2.4.3.1 ***Data Pre-Processing***

The most time-consuming component of the geodatabase migration is the data pre-processing. This is the step whereby the source coverages are massaged and converted into an intermediate, transportable format that can be readily loaded into the geodatabase. We have found that a mix of formats works well for this purpose; we will utilize both shapefile formats and personal geodatabases to prepare the data for loading. Pre-processing for each layer typically consists of:

1. *Determine target geodatabase feature class, or feature classes;*
2. *Split/merge coverage into separate shapefiles or personal geodatabase (pgdb) feature classes, as warranted by the geodatabase data model;*
3. *Implement subtypes in the pgdb;*
4. *Alter attribute fields to conform to target model;*
5. *Implement attribute domains as necessary;*
6. *Associate/re-link annotation feature classes;*
7. *Implement geometric network;*
8. *Validate geometric network; and*
9. *Mosaic imagery/convert ASCII terrain data to TIN structure or point shapefile.*

Note that we will have already pre-tested these processing procedures during the Prototyping phase, so the steps that are needed for most layers will already be well- understood and documented.

2.4.3.2 DATA LOADING

*The actual data loading for Phase I data will take place over a **period of a few weeks**. We will use ArcSDE batch scripts to load the data from the processed pgdbs, shapefiles, imagery files, and terrain datasets, and database configuration keywords will be applied as appropriate to implement access and security.*

2.4.4 PHASE II

*Phase II will be handled somewhat differently. The pre-processing of data and the data loading will be the same technical steps, but because the Phase II data layers are mission-critical, we must perform these steps in a manner than **minimizes downtime**. We will accomplish this by creating automation scripts that will pre-process each of the mission-critical input coverages. These will serve the same purpose as the pre-processing steps that will be performed for Phase I, but because they are scripted and automated, we will be able to pre-process these data in a matter of days. The development and testing of these scripts against the source coverage data will be significant component of the Prototype task.*

The Phase II, mission-critical data will all be processed over a single weekend, or a few weekends depending on FCDMC's staffing and network constraints. Ideally we will begin

work on a Friday after the close of business, and we will complete the migration of all vector, imagery, and terrain data by the start of business on Monday morning. This work will be performed in coordination with FCDMC; it is expected that FCDMC will provide the necessary access to accomplish this transition, or work with Dewberry to develop an acceptable alternative.

Our scripts will automate the data pre-processing; we will also have pre-tested ArcSDE loading scripts to insert the data into the geodatabase. This means that the actual time of migration will take place within a matter of a few hours (again, this would ideally be performed over a weekend to cushion that time frame).

2.4.5 QUALITY CONTROL (FINAL SCHEMA TEST RESULTS)

We will integrate standard quality assurance and quality control procedures throughout the data migration process. Our quality assurance is applied through the standards and procedures that we put in place to ensure adherence to our migration specifications, and is defined through our migration planning. Quality control will be applied through a series of inspections that will be performed at two stages:

1. *The prepared source data will be checked against the original source data. This will consist of visual inspections of geometry, as well as a count of database records, and a review of each of the attributes for completeness, content, and fidelity against the original data source layer.* ***A more complete list of checks is described in the Prototype implementation section****. Issues that are identified through this quality check will be rectified prior to proceeding with data migration.*
2. *The ArcSDE feature class data will also be checked against the prepared source data, again using visual inspections, summaries of database records, and reviews of attributes (see Prototype section for complete list of checks).*

We will document the quality control tests and present the results in a ***Final Schema Test Results*** *report so that FCDMC may have full confidence that the data migration is successful and complete.*

2.5 OPERATIONAL DOCUMENATION AND TRAINING:

Documentation and training are key components to ensuring the success of the geodatabase implementation. We recognize that FCDMC wishes to have documentation for the finalized geodatabase design, as well as documentation for any customized code and implementation procedures. We will provide finalized versions of all of these documents. The development of this Final Operational Procedures Document will be a natural outgrowth of the needs assessment, design, prototyping, and migration effort, and will be aided by our thorough documentation of procedures throughout. We will prepare and deliver a draft of the Operations Procedures manual to FCDMC. Once comments have been made, we will revise and finalize this document. Note that this satisfies the requirement for a ***Final Operational Procedures*** *document.*

We will also provide a series of two training classes. Dewberry has provided extensive geospatial training to clients in the past, including training on DFIRM databases to hundreds of GIS professionals (including FEMA staff). We will develop these training classes in concert with the development of the geodatabase design and geodatabase migration. ***Our trainers will be active participants in the overall project****, not just personnel who will step in at the end of the project to perform training. This means they will be subject matter experts on FCDMC's geodatabase design and implementation; they will able to discuss the inner workings and rationale behind the design decisions. Our development of these courses will also be informed by our documentation of preliminary training requirements during the needs assessment. We have assumed that there will be one offering of each course, though this can easily be altered to accommodate FCDMC's needs depending upon the number of students and the desired class size.*

2.5.1 H.I.S. GEODATABASE INTRODUCTION COURSE

We propose to offer a H.I.S. Geodatabase Introduction course to a broad audience. This class will be suitable to all H.I.S. database users (even casual users). We recognize that most of FCDMC's staff has extensive experience with the coverage data model, as well as working knowledge of the ArcGIS platform. We will conduct a training course that reinforces this ArcGIS knowledge, and relates the existing environment to the new environment, including a discussion of the migration pathway for many of the data layers. Core ArcSDE geodatabase concepts will also be covered, such as:

- *Versioning and multi-user editing;*
- *Reconciling, posting, and compressing;*
- *Feature datasets and feature classes;*
- *Attribute domains and validation;*
- *Editing with topology; and*
- *Editing and maintaining a geometric network.*

Each of these topics will be discussed and demonstrated within the framework of the new H.I.S. geodatabase. This will be a two-day course in a training lab environment, and will take the form of lectures interspersed with classroom exercises. We will work with FCDMC to set up a suitable training environment (e.g. a copy of the geodatabase in a new SQL database instance) to conduct the training.

2.5.2 GEODATABASE ADMINISTRATION COURSE

We will also conduct a more advanced training session for FCDMC staff members that will be responsible for actively administering the geodatabase. This class will be held at a level suitable for senior GIS Analysts, and Database Administrators. During this class we will cover topics such as:

- *Complete review of geodatabase design and architecture;*
- *Data migration/implementation procedures;*
- *Version management;*
- *Performance monitoring and tuning;*
- *Transactional log management;*
- *Index management (including spatial indexes);*
- *Backup procedures and protocols; and*
- *Miscellaneous administrative topics (e.g. rebuilding topology classes and geometric networks).*

2.5.3 REVISED DATA DELIVERY SPECIFICATIONS DOCUMENT

*The final step in this task will be to develop and deliver a revised **Data Delivery Specifications for the Hydrologic Information System** document. This revised document will be natural outgrowth of the Visio data modeling effort, formatted into a Word document, with additional notations and descriptions as necessary to fully describe the feature classes, attributes, and domains, as well as specific delivery requirements and procedures.*

*We will provide a draft of this document for review by FCDMC, and we will finalize the **Data Delivery Specifications for the Hydrologic Information System** document once comments have been received.*

2.6 APPLICATION PLANNING:

Identify potential geodatabase applications and enhancements that would improve worker efficiency or promote open access to data at the District or that might protect and improve the environmental quality of life in Maricopa County.

*Our approach to the needs assessment will provide a preliminary listing of applications and application functions that need to be migrated to, or created for, the new geodatabase environment. We believe that **these application requirements must be documented during the needs assessment**, rather than waiting until the geodatabase has been implemented. By performing this step up-front, we will ensure that the geodatabase model contains the necessary placeholders and elements that will be needed to serve the application requirements. We have more fully described our approach to collecting the application requirements in the Need Assessment section.*

The applications requirements will take the form of UML use-case and sequence diagrams, in Visio, as well as a matrix of functional requirements organized into proposed application modules. The functional requirements and modules will be assigned a preliminary priority ranking for implementation. We will suggest potential application development platforms such as:

- *ArcGIS Desktop applications;*
- *ArcIMS applications (both intranet and internet);*
- *ArcGIS ArcEngine desktop applications; and*
- *ArcGIS Server enterprise applications.*

We will also evaluate more industry-specific solutions, such as:

- *Holistic approaches for creating and managing flood hazard engineering (H&H) and mapping data (e.g. implementation of Dewberry's **GeoFIRM** solution)*
- *Tools for readily integrating FCDMC's Letter of Map Revision (LOMR) data*
- *If not addressed during the geodatabase design, we will examine tools for integrating components of FCDMC's Flood Insurance Study (FIS) text, including profiles (possibly even including full text for all 17 documents, and linking all 1300+ profiles)*
- *Applications and tools for managing critical infrastructure data*

2.7 SCHEDULE FOR DELIVERY/PROJECT TIMELINE:

Upon receipt of Purchase Order to engage on any deliverable (Sections 2.1-2.6) the contractor shall be responsible for providing a detailed Schedule of Delivery/Project Timeline for that deliverable. The Delivery Schedule/Project Timeline shall be formally approved by the Flood Control District in writing prior to engagement.

2.8 CONSTRAINTS AND ASSUMPTIONS

The host platform will be a Dell 2650 PowerEdge equipped with dual 2.6 Ghz processor and 2 gigabytes of RAM. The operating system is Windows 2000 Server.

The District deploys a continuum of GIS software from ESRI. The core product suite is ArcGIS 9, and includes ArcInfo Workstation (floating) and ArcView 9 (floating &single-user).

The geodatabase shall be implemented with no adverse impact on current computer network services.

At minimum, geodatabase performance shall be equivalent to the HIS.

CLARIFICATION:

How will Dewberry determine if FCDMC's computing infrastructure can support a large-scale, enterprise geodatabase?

We view the assessment of the computing infrastructure as an integral part of the Business Process analysis that we will perform during the needs assessment phase of this project (see page

19 of our proposal, bullet "d"). We have recently performed similar assessments for our GeoFIRM map production system, as well as for Loudoun County Sanitation Authority, Frederick County Sanitation Authority, and Alabama Emergency Management Agency. All of these assessments resulted in recommendations to alter or improve computing infrastructure to handle the needs of an enterprise-class geodatabase.

There are several major elements that must be assessed when analyzing a computing infrastructure to determine if it will support the needs of a large-scale enterprise geodatabase. These are:

1. *Intended use (overall vision for how geodatabase will be utilized)*
2. *Network infrastructure (Routers, switches, hubs, cabling, etc.)*
3. *Server infrastructure & configuration (processors, storage, memory)*
4. *Client machine infrastructure (processors, storage, memory)*
5. *Software*
6. *Security and policy constraints*
7. *Number, type, and connectivity of users*

We will assess each these elements, primarily through a series of interviews with FCDMC's technical support staff and IT management. The results will be documented as part of the business process component of the needs assessment. UML diagrams showing relationships among actors and components of the system as well as Use Cases may also be created to better describe the current and planned infrastructure environment. At the end of the needs assessment, we will be able to make recommendations for upgrading computing infrastructure as necessary.

Our experience has shown that network hardware and infrastructure (routers, cabling, switches, etc.) are typically NOT major bottlenecks to performance, unless the components are well out of date (e.g. use of 10Base-T Ethernet). End-user desktop machines are also not likely to be a major issue, as most desktops can run ArcGIS software adequately (although newer machines are a plus, and those users that perform editing are likely to need more robust workstations than the standard hardware image). Identifying GIS server and data storage infrastructure needs will likely be the focus of our assessment.

We use a variety of tools to help us make recommendations for the overall system architecture. One tool that we've used in the past is the chart shown below, published by ESRI. This chart gives recommendations for numbers of server processors and RAM configurations for a given number of peak concurrent clients accessing an ArcSDE server. Our experience has indicated that undersized hardware, or poorly optimized hardware configurations, usually prove to be the largest limitation to achieving the desired performance. A key component in assessing the server infrastructure is determining the number of users and the type of users (viewers, editors, etc.) and the number of transactions each client will impose on the planned GIS servers.

CLARIFICATION

Should MCFCD install SQL Server and SDE on a different server than where the enterprise SQL Server is installed? Will the performance of the enterprise SQL Server take a performance hit if installed on the same server?

Dewberry will assess the installation of SQL server, and potential impacts on existing operational databases, as part of our needs assessment. However, the preliminary answer to this question is Yes. It is likely that the geodatabase (SQL and SDE) should be installed on a separate server from the enterprise SQL server due to performance concerns.

We have performed similar installations recently, and we've learned that in general, a vector-based SQL/SDE geodatabase is generally difficult to overload from a processing standpoint. ArcSDE and SQL perform well in managing user requests, disseminating data to users, and writing edits back to the database. However, our experience with storing larger raster and point LiDAR data in ArcSDE leads us to make the preliminary recommendation of separating the geodatabase from other business functions. The raster and terrain data that will be stored in

FCDMC's geodatabases represent a significant processing and bandwidth load that will heavily tax the resources of the host machine. Segregating the geodatabase from the functions of FCDMC's enterprise SQL server is therefore a likely recommendation, as it will improve the performance of both business functions

2.9 **FACILITIES**:

During the course of this Agreement, the County shall provide the Contractor's personnel with adequate workspace for consultants and such other related facilities as may be required by Contractor to carry out its obligation enumerated herein.

2.10 **TAX:**

No tax shall be levied against labor. It is the responsibility of the Contractor to determine any and all taxes and include the same in proposal price.

2.11 **CHANGE ORDER MANAGEMENT**

Any revision to the specified Scope of Work, Task, or Deliverable must me documented via a Formal Change Order Process.

The Maricopa County Project Manager is ultimately responsible for the overall management of the project scope, and therefore responsible for the final approval of all change requests. The Contractors Project Manager will be responsible for sizing, pricing, and implementing approved Change Requests.

Prior to commencing work on this project, the contracted vendor is required to submit an applicable Change Order Request Form for approval by the Maricopa County Project Manager. The resulting form will serve as the only recognized means to alter/change the applicable Scope of Work (as designated in this contract).

2.12 **ASSIGNED PERSONNEL**

Any changes to the identified primary staff must be submitted in writing to the designated Maricopa County Flood Control District Project Manager. Maricopa County will reserve the right to interview and/or have final approval on ay proposed changes to the staffing model (Exhibit C).

2.13 **ADDITIONAL CLARIFICATIONS:**

1. After this year's imagery is acquired, FCD will have approximately 6 TB of raster data. This information is used by other non-GIS software packages. How will aerial raster data sets be incorporated into Dewberry's geodatabase design to satisfy all district needs?

FCDMC has an extensive historical catalog of aerial imagery from 1937 through the latest set of 4" pixel orthoimagery to arrive in 2005. The goal would be to optimize the data to allow easy and effective access to this imagery data to both GIS and non-GIS uses is important with such a large set of data. The key to almost all raster storage and retrieval solutions is a data compression strategy. Although we recommend individual raster and mosaiced rasters in ArcSDE as a preliminary storage strategy, there are several methods and tools that may be worthwhile to consider.

Before deciding on a final recommendation or plan, Dewberry will interview end users of the imagery to find out how they access it now, what it is used for, and what frequency it is used. Only then will we decide on a course of action (with full concurrence from FCDMC). Some possible solutions are noted below:

a) ArcSDE - Storing imagery in an ArcSDE 9.1 or 9.2 environment would put the data into a relational structure that has indexing, can store mosaics and can be optimized. The data is

natively accessible to the ArcGIS products and also to non-GIS applications through the ArcSDE C-API. Some kind of separate SDE service may be created for the raster data sets to reduce the access burden for data that users are viewing and editing. Individual images stored in ArcSDE could not be retrieved by the casual user (e.g. the general person adding an imagery to their powerpoint presentation) in a traditional manner. Instead some kind of Intranet web interface or custom tool would need to be created to allow the non-GIS users to pick the image and download to their hard drive for temporary use, much like they would do if grabbing an image from an internet site. This type of tool could also service Internet users wanting to access FCDMC's imagery data warehouse.

b) Traditional network storage with some off-line data – This involves having imagery stored in network folders with image catalogs for easier access by ArcGIS users. Data storage management can be optimized by controlling the location of the files on different servers depending on usage. Little-used files can be stored in off-line media.

c) ArcServer / ImageServer – Imagery data is maintained in a traditional file structure on its own server instead of storing the data in an RDBMS. The imagery is distributed with the ArcServer interface tools to GIS users and appears as regular files on its own server for non-GIS users. With Image server, all types of rasters (imagery and DEMs) can be distributed to end users. This is new technology for ESRI at ArcGIS 9.2.

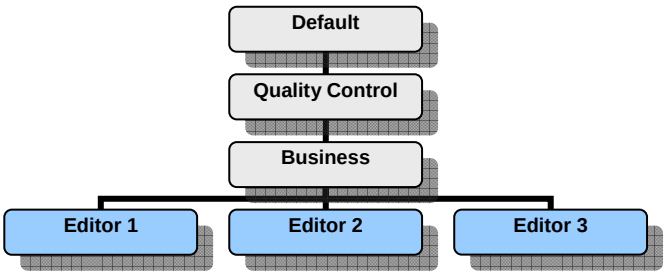
Third Party Imagery retrieval programs – There are other vendors who specialize in imagery retrieval programs. Some examples are, GeoExpress by LizardTech; ImageConnect or ImageBuilder by StewartGeo; SourceView by Momentum Systems Ltd. If FCDMC has researched or is interested in any additional 3rd party tools, this can be explored during the needs assessment phase.

2. Do we need to consider having a production SDE database and business SDE database setup? The business SDE database would be read only. It would be a copy-out of the production SDE database. It would be there to avoid performance issues (people editing, checking data in, etc.)

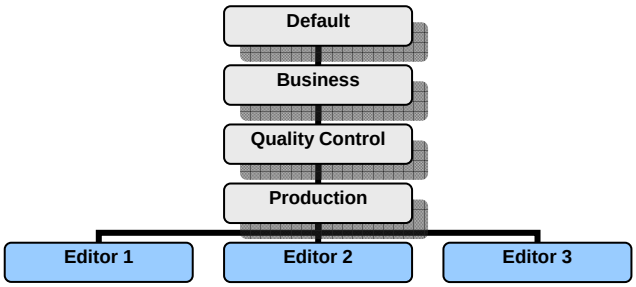
Dewberry will also assess the appropriate configuration of the geodatabase, including the possibility of mirroring or replication of the geodatabase (as indicated by this question), as part of our needs assessment. The final answer to this question will depend on the results of the needs assessment, particularly on the number of users that will be accessing the geodatabase simultaneously, and the medium through which they will access it. This will essentially be an analysis of the number, and nature, of anticipated peak database transactions. However, we have generally found that it is NOT necessary to replicate the geodatabase solely for the purpose of addressing performance by read-only users. Replication might be performed if it is necessary to have off-site copies, to support remote functions, or to support a heavily trafficked ArcIMS site. In FCDMC's case, it will probably not be needed as a mechanism to improve performance.

ArcSDE's robust versioning tools provide sufficient functionality to segregate production work from general business use, and with proper ArcSDE management versioning is fairly high-performance. We have recommended the versioning structure shown as "Proposal Versioning Structure" as a 'straw-man' in our proposal, but there are literally dozens of ways to construct a versioning schema to meet different business needs. A second versioning approach that may be more suited to FCDMC's needs is also shown here as "Alternate Versioning Structure". Either of these might be appropriate.

Proposal Versioning Structure



Alternate Versioning Structure



3. If our shop is not a multi-editing environment (for the most part), should we use the new database design in the 9.2 personal geodatabase version (no file size limits) versus an SDE database? What factors would be considered when addressing this issue?

*Dewberry will also review the possible use of the 9.2 personal geodatabase version (specifically the "ArcSDE workgroup" version) as part of our assessment. Given the expected number of users and the requirement for a robust, stable solution that will support a variety of business needs and applications, it is our preliminary recommendation that FCDMC utilize the **full** ArcSDE geodatabase implementation.*

Our evaluation to arrive at the final decision will include an examination of factors such as security, performance requirements, transaction management, disaster recover, and scalability. We have conducted a preliminary evaluation of these factors, and our analysis is provided below.

The ArcSDE workgroup version is suitable for small teams of users and editors, and does not require a separate RDBMS (e.g. SQL Server), nor does it require a database administrator. However, it is not yet proven as a technology, and more importantly it lacks the following characteristics that are provided with full a full RDBMS/ArcSDE implementation:

1. *Database security – Although the file based ArcSDE will offer some level of security, it will not be the tested and proven standards provided by a true RDBMS system such as SQL Server or Oracle.*
2. *Performance – RDBMS systems such as SQL Server and Oracle can be tuned to optimize data storage in response to common queries and requests. It is highly unlikely that the ArcSDE workgroup will provide such functionality.*
3. *Transaction management – With SQL Server, the ability to 'roll-back' changes is provided, including changes made by individual users. This ability is proven and tested for SQL Server and Oracle, but may not even be available for ArcSDE workgroup.*
4. *Disaster recovery – Related to transaction management is the element of disaster recovery (which also includes a full database backup capability). SQL and Oracle allow for full and incremental backups, and are supplemented by transaction logs; it is doubtful if ArcSDE workgroup provides such robust functionality.*
5. *Scalability – ArcSDE workgroup is somewhat scalable in that it will support small teams of users, and fairly large geodatabases. However, it probably will not accommodate the number of users and the size of geodatabase that FCDMC is likely to implement.*
6. *Version management – Enterprise ArcSDE provides tools for full version management. The workgroup ArcSDE solution for version management is not as robust as full ArcSDE, again owing to security limitations and RDBMS robustness.*

7. Interoperability – The new workgroup ArcSDE is based on a new file-based data structure that is unproven. ArcSDE data based in SQL Server will be much more flexible and much easier to integrate with other enterprise applications.

For all these reasons, we consider anything less than full ArcSDE to be a poor choice for serving as FCDMC's enterprise geospatial data hub. We will evaluate ArcSDE workgroup as a part of our needs assessment, but our preliminary assessment leads us to recommend full ArcSDE.

EXHIBIT C
STAFFING MODEL

DEWBERRY & DAVIS, LLC, 8401 ARLINGTON BLVD. FAIRFAX, VIRGINIA 22031-4666

PRICING SHEET: S073710/B0700175/NIGP 92018

Terms:	NET 30
Vendor Number:	W000003603 X
Telephone Number:	703/849-0111
Fax Number:	703/849-0182
Contact Person:	Mike Beardslee
E-mail Address:	mbeardslee@dewberry.com
Company Web Site:	www.dewberry.com
Certificates of Insurance	Required
Contract Period:	To cover the period ending **March 31, 2007.**